The BOOK *of* KNOWLEDGE

To Inspire ambition, to stimulate the imagination, to provide the inquiring mind with accurate information told in an interesting style, & thus lead into broader fields of knowledge—such is the purpose of this work.

VOLUME

2

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After Hans Holbein; Walker Art Gallery, Liverpool

HENRY VIII AND HIS CARPET

This painting is a faithful copy of a portrait by Hans Holbein the Younger, destroyed in 1698. It well shows the master's fine drawing, rich colour, decorative sense, and insight into character. A point of interest is linked with the article CARPETS AND RUGS, a passage in which (p. 263) explains how painters often show carpets of the past of which few or no examples survive. This is an Anatolian carpet.

The BOOK *of* KNOWLEDGE

A Pictorial Treasury of Reading & Reference for Young and Old

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THE BOOK OF KNOWLEDGE

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HERE AND THERE IN THIS VOLUME

When you are just looking for "something interesting to read," this list will help. With it as a guide, you may wander through storyland, visit far-away countries, meet famous people of ancient and modern times, review history's most memorable incidents, explore the marvels of nature and science—in short, find whatever it is that happens to suit your fancy at the moment.

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COLOUR AND GRAVURE PLATES AND PAGES

IN THIS VOLUME

KEY TO PRONUNCIATION

Most of the subject-headings in THE BOOK OF KNOWLEDGE require no special indication of the way in which they should be pronounced. Where guidance is necessary the pronunciation is given in brackets, usually at the beginning of an article: a stress mark is placed *after* the stressed syllable (*e.g.* adriat′ik), and the following devices are used:

ah = a as in father
aw = a as in ball
ä = a as in bare
ê = vowel sound in fern, word, girl, curl
ow = vowel sound in now, bout
oi = vowel sound in noise, boy

Unmarked vowels have their **short sound,** as a in hat, e in bet, i in bit, o in not, u in but, oo in book

Marked vowels have their **long sound,** as in hāte, bē, bīte, nōte, tūne, bōōm

Vowels in Italics have a slurred or obscure sound as in abet (*a*bet′), recent (rē′sent), conform (konfawm′), luscious (lush′*u*s), tailor (tā′lor)

th = first sound in thing, thank
th = first sound in the, that
zh = s in measure, leisure

g = hard g, as in good, girl
j = soft g, as in gem, ginger
kh = guttural, as in loch

LIST OF ABBREVIATIONS

The abbreviations most commonly used throughout this work are noted below: longer lists of abbreviations often met with in reading or conversation are given under the heading Abbreviations (Volume 1) and also in the Fact-Index (Volume 8).

A.D., *Anno Domini* (in the year of Our Lord; of the Christian era)
a.m., *ante meridiem* (before noon)
b., born
B.C., before Christ
C., Centigrade
c., *circa* (about)
Co., county, company
d., died
e.g., exempli gratia (for example)
etc., *et cetera* (and so forth)
et seq., et sequens (and following)
F., Fahrenheit
h.p., horse-power
i.e., id est (that is)
lb., pound, pounds (weight)
MS., MSS., manuscripts, manuscripts
N.B., *nota bene* (note well)
oz., ounce, ounces
p.m., *post meridiem* (after noon)
pron., pronunciation
Q.C., Queen's Counsel
sq. m., square miles
St., Saint
U.S.A., United States of America
U.S.S.R., Union of Soviet Socialist Republics
viz. videlicet (namely)
yd., yard

The FRAMEWORK *of the* BODY

Bone. This is the very dense and durable substance which forms the skeleton of man and other animals. The skeleton is a permanent framework ; the flat and hard bones of the skull protect that delicate and important structure, the brain ; the backbone or spine shepherds downwards the important nerves which run off at intervals to supply structures at the various levels.

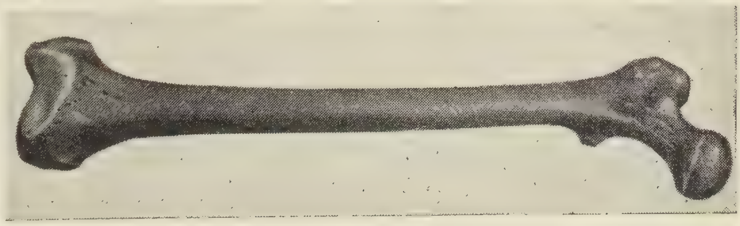
The schoolboy's description of a man's spine is not a bad one. " His head sits on one end of it, and he on the other." From the spine spring the ribs, twelve a side, making a safe, bony cage for the lungs and heart. The attachment of muscles to the long bones of the leg makes movement and locomotion possible, while to the bones of the arm, wrists, and fingers man owes all his skill in handicraft and trade.

When man first got on his hind legs, in ages infinitely remote, the whole picture of his development began to take on new values. Now he could walk on his two hind limbs : with his two front limbs thus set free, and with the fingers increasing in sensitivity and skill, he could develop his abilities along lines hitherto impossible for him. This upright position also gave new significance and importance to the human face. While man was on all fours it was only the top of his head which met the impact and gaze of the world.

Calcium and phosphorus are of essential importance in forming the hardness and unyieldingness of bone, while soft substances which infiltrate the material of bone lend toughness to the skeleton. In the skeleton of a child there is much cartilage and soft substance, and so the bone is elastic and not easily broken. In an old person the soft structure has been absorbed, and so the bone is brittle. One may think of bone as " dead," but on the contrary it is very much alive ; it is traversed and pierced by a network of very fine vessels carrying lymph, by nerves, and by very fine blood-vessels which branch out through all its structure. Bone marrow is formed and is found in the hollows in the middle of the long bones (such as those of the arms and the legs), and in the flat bones (such as the breast-bone). Here, strange as it may seem, are the blood-factories of the red cells and of some of the white blood-cells (*see* BLOOD). When mature, these cells drift themselves into the minute blood-vessels and thence into the general bloodstream. Marrow forms a valuable food, rich as it is in blood-forming elements.

The surface of bone is coated with a fibrous membrane, the periosteum (*peri*, around ; *os*, a bone). Flat bones grow by laying down hard material between the layers of periosteum ; long bones by laying down hard material in cartilage—rather like the rings in the wood of trees. Before birth, little hard masses, known as the centres of ossification, are present in the bones. Before birth, after birth, and in the growing animal, the



TYPES AND THE BLOOD SUPPLY OF BONES

Blood is supplied to the interior of bones partly by a main artery, and partly by a fibrous membrane named the periosteum (left). The blood vessels lie in minute channels which traverse the bone in all directions. Bones are divided into four categories : long, such as the thigh-bone (bottom) ; short, such as the heel bone (top right) ; irregular, such as a vertebra (top centre) ; and flat, like the shoulder blade and the breast-bone.

ossification centres stretch out bony tentacles until, by their infiltration, the whole bone becomes hard and dense. The ends of the long bones have only a lacy network of bone inside them. But this does not lessen their strength, and one is reminded of an arch which, by some strange law of stress and strain, proves to be even stronger than the adjacent solid wall on either side.

Increase in height is possible only while the growth of the long bones is not yet complete, a completeness which occurs at varying ages. A long thigh-bone is of great advantage to the appearance of men and women, lending them swing and grace in movement. At puberty—the stage of growth at which a boy or girl leaves childhood—the growth of the thigh-bone ceases ; and if it is short, the owner is destined to "waddle," ducklike. But extracts of certain suitable endocrine glands may be given by the doctor if the growth factor in bones is judged to be seriously lacking. (*See* GLAND.)

FRACTURED SHIN-BONE
The tibia or shin-bone is the larger of the two bones of the lower leg ; the smaller is the fibula.

Broken Bones

Because of the hazards of modern life, fractures of bones have become common, and have led to a fascinating chapter in surgery. When the ends of a broken bone are held together in proper position, the living bone cells join the ends together, and the bone may become as serviceable as before with no sign of malformation. Plaster of paris and similar substances are used to prevent the movements of the fractured bones, so that natural healing can take place. Splints, such as the Thomas splint for the fractured thigh-bone, are also of service, but on the whole splints are now used chiefly in first-aid work. A metal plate may be applied to the bone itself ; or a pin of metal, plastic, or bone may be introduced. Moreover, a graft of living bone and periosteum may be inset, either from the patient himself or from the body of another, and these alien bone cells will multiply and repair the damage. X-rays have been of untold value in assessing any damage to bone and are used in almost every case of injury or accident.

Rickets is a disease of bone which in the past has caused much deformity and distress but is seldom seen to-day because of the improved feeding of children. It was due to a defect in the chemistry of calcium and phosphorus on which the hardness of bone depends—a defect depending on a shortage chiefly of vitamins A and D, though other vitamins are also involved. Sunlight is also essential in the prevention of rickets.

Bone has many industrial uses, but the synthetic chemist, working in his laboratory, has devised other hard and durable plastic materials which are often far more suitable. In another respect, however, bone keeps its age-old supremacy ; this is as a fertiliser of the soil, in the form of bone-meal. Animal charcoal, or bone-black, is made by burning bones in iron retorts.

Boniface, SAINT (680–755). In 716 the worshippers of Thor and Woden in what is now Germany began to turn to Christianity through the labours of a Wessex man. He was originally called Winfrid (or Winfrith), but he later took the name Boniface (pron. bon′ifās), meaning doer of good. He was born at Crediton, and educated in monasteries at Exeter and at Nursling, near Southampton. He made up his mind to be a monk at the age of seven and never once swerved from this decision. In 716 Boniface went to Frisia (present north-east Germany), and for forty years he worked to convert the pagans of that and neighbouring parts of the Continent—preaching, baptizing, consecrating churches, founding monasteries, and everywhere he went establishing the authority of the pope. He and some devoted companions bore hardships without number in these then savage lands, and at last he was martyred at Dokkum (near Leeuwarden, in the modern Netherlands). In time he came to be honoured as a saint and the Apostle of Germany.

Here is one legend from the life of this great missionary. It is said that he found a group of priests, supposedly Christian, performing the rites of heathen worship under a sacred oak in the heart of the gloomy forest of Geismar.

"Down with that tree," cried Boniface, "for it is an altar to false gods ! "

But the Hessians called upon their pagan gods to curse anyone who should touch the tree, and no one dared to lift the axe against it.

Then said Boniface, "Behold, I will chop it down myself." He applied the axe, and when he had cut into the trunk only a little way, a breeze stirred, and the oak crashed to the ground in four pieces while Boniface stood unharmed. The Hessians, awed, accepted this as proof of the superiority of the Christian God, and agreed to accept Him. Out of the timber of the fallen oak Boniface built a Christian chapel.

Boniface, POPE. Nine popes have borne the name Boniface, beginning with BONIFACE I, pope from 418 to 422. The pontificate of BONIFACE VIII, pope from 1294 to 1303, was important because it marked the decline of the medieval power of the Papacy. By his attempts to exercise authority in temporal as well as spiritual affairs, this pope was involved in many bitter conflicts.

In one of these, with Philip IV of France, the aged pope was seized at his summer home at Anagni and treated with such indignity that he died a month after his release. BONIFACE IX, pope from 1389 to 1404, was one of the pontiffs in the period of the "Great Schism" (1378–1417), the division in the Roman Church that followed the return of the Papacy to Rome while anti-popes reigned at Avignon (see article). Though his private life was blameless, he sold benefices and dispensations to the highest bidders.

Bonn. Chosen capital of the German Federal Republic in November 1949, Bonn is an attractive city in pleasant, hilly surroundings on the left bank of the Rhine, 12 miles south of Cologne. The Romans built a fortress here. The medieval town grew in importance when it became the residence of the ruling elector-archbishops of Cologne in the 13th century. Bonn has several remarkable churches built during the 12th, 13th, and 14th centuries, and an impressive palace which houses the important university, founded in 1818. There the German royal princes used to study; so did the young Prince Albert who was later to marry Queen Victoria. Apart from learning, Bonn had a tradition for music and arts created by the Electors, mostly sons of the Imperial Hapsburg dynasty. Beethoven, for example, was one great musician born in Bonn who started his career at their court. The house where he was born is now a Beethoven museum.

With only 50,000 inhabitants in 1900, Bonn had reached 100,000 shortly before the Second World War; but after it was chosen as the seat of the Federal government it grew by as much again within little over two years and went on growing very fast. The result is a queer, yet not unattractive mixture of styles. In the old, historic part of the city are the great Romanesque minster, the Gothic churches, the Renaissance palace of the university, and the often Baroque private dwellings of former days, mostly repaired again after having been severely damaged by bombing. Narrow streets and large parks and avenues link this to the newer part, with huge, new "functional" buildings such as the parliament and buildings for the ministerial staff, or old mansions adapted to their present use as government offices. Parliament meets in what was formerly a teachers' training college. Bonn's industry—mainly pottery and paper—though important, is unobtrusive. There are excellent connexions, by electric and steam trains and by the Rhine, over a wide area, and there are sundry health resorts and beauty spots near by. Pleasant boat excursions on the Rhine are a great attraction.

BONN, CAPITAL OF THE GERMAN FEDERAL REPUBLIC

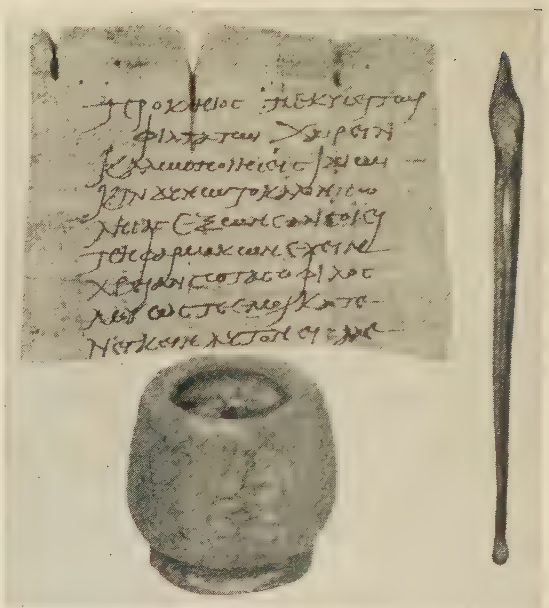
On November 3, 1949, the university town of Bonn became the capital of Western Germany, and the Federal parliament meets in the building before which the flag of the republic (horizontal stripes of black, red, and gold) is flying. The capital is situated on the west bank of the river Rhine, about 12 miles south of Cologne. It was the birthplace of Beethoven, and the house in which the composer was born survived havoc wrought during the Second World War.

BOOKS *and* THEIR MAKING

Book. The printed and bound book of to-day has a long history, which can be traced back for more than 5,000 years. Unfortunately comparatively little is known of the greater part of this period, and that little comes from the careful researches and deductions of archaeologists during fairly recent times. The earliest beginnings go back to Egypt, China, and Assyria in the third millennium B.C. In each of these countries there is evidence of the existence of writing materials and of the recording of official and private transactions in writing about this time.

In Egypt the papyrus plant was used to provide the writing surface. This plant grows in the swampy delta of the Nile. The stem, which is three-cornered and grows to a height of several yards, can be cut in very thin strips. These strips, if they are pressed and laid alongside one another, with a second lot laid across the first in the other direction, contain enough natural glue to form sheets. The papyri exhibited in the British Museum show these layers quite plainly. When these sheets were sized and dried and polished they provided an excellent surface for writing—but as a rule the writing was confined to one side, running the same way as the strips. Leaves of papyrus were glued together to make a long roll—these may be sometimes as much as twenty yards long—with a stick (*umbilicus*) at each end ; the writing was in columns and gave the impression of a series of pages. For reading, the roll was held in the right hand and unrolled column by column, while the left hand rolled up, on one stick, the part that had been read. When the reader had finished, the roll was wound tightly on the other stick again, to be ready for reading once more. A slip of vellum was attached to the top of the roll to indicate what the contents were. The rolls were kept in cylindrical cases made of parchment.

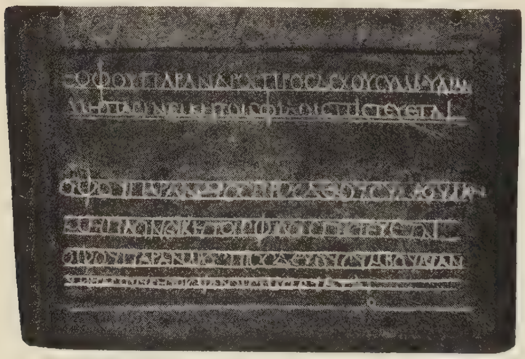
The writing used by the Egyptians on the papyri was not the ancient picture-writing, called hieroglyphics, which is found on the monuments from ancient Egypt, but a more running script which is called hieratic (the writing of the priests) : later a further simplification produced what is called demotic (the writing of the people). The oldest papyrus known goes back to 2400 B.C., but papyrus rolls must have been used a good deal earlier than this because one of the hieroglyphics themselves shows a papyrus roll.



British Museum

HOW ANCIENT BOOKS WERE WRITTEN

The Greeks and Romans wrote on papyrus manufactured—chiefly at Alexandria—from rushes. They made their pens of reed or bronze cut to a point, and used sepia obtained from cuttlefish for their ink. The ink-pot shown in this picture is of Roman pattern and date.



British Museum

GREEK CHILD'S COPY-BOOK

This ancient writing tablet resembles very closely the slates once common in British schools, except that in writing, the wax surface was scratched away and the wooden base showed through. The one here is a school exercise book ; the teacher wrote the two lines at the top, and the child copied them underneath. It dates from the first century of the Christian era.

A reed pen was used to write with, and the ink was made of soot or carbon mixed with water and some kind of adhesive—its quality can be judged from the manner in which after all these thousands of years it has preserved its deep black sheen.

At the same time as the papyrus roll was being developed in Egypt, the Chinese were using thin wooden boards on which words were scratched with a [slate] pencil ; at a later period ink was used here, too, with a bamboo reed. Virtually none of the Chinese wooden manuscripts has survived, chiefly because they were all burned at the order of the emperor in 213 B.C. This wholesale destruction had produced a period of great literary activity in China during which writers attempted to recall and re-edit earlier Chinese literature. For this purpose wood was no longer used. Writers turned to silk, on which they wrote with either a bamboo pen or a camel-hair brush. Soon the efforts of the Chinese to find other materials suitable for writing on succeeded, and paper as it is known to-day was produced. This was made as early as the end of the 1st century A.D.

MASTERPIECE OF AN ANCIENT SCRIBE

Many old manuscripts were elaborately illuminated in colour by monks and scribes, and so skilfully were the pigments made that many of the pictures still retain their colour. Above is an example from an eighth-century copy of the Gospels, called the Book of Kells because it was made at the monastery of Kells, in Ireland.

In Assyria the material which was used for keeping records was clay. The characters were impressed in the clay while it was moist and soft, with an instrument of wood, ivory, or metal, and the clay was then baked hard in an oven. At Nippur, "Record Rooms" filled with clay tablets have been found which go back to the latter half of the 3rd millennium B.C. King Assurbanipal's library at Nineveh, which was used in the 7th century B.C., contained 22,000 tablets when it was discovered by the archaeologists Layard and Rassam in the 1850s.

None of these materials was directly responsible for the modern book. The link was yet another substance—vellum or parchment (Latin name *charta Pergamena*, from Pergamum, where its use was first fully established). Leather had been used as a writing material from quite early times among Egyptians, Jews, Assyrians, etc., but it was only in the 3rd century B.C. that a method of treatment was found which made it suitable for ink. The skins used were sheep, calf, or goat. The fur was removed, the skin was scraped and washed in lime and water to remove the fat and then, after drying, rubbed with fine chalk and smoothed with pumice. The result was a smooth surface suitable for writing upon on both sides. It was. moreover, more lasting than papyrus and, unlike papyrus, could be cleaned and used again. Thus there have come down from the Middle Ages, when vellum was costly, a number of *palimpsests* (i.e. manuscripts from which an earlier text has been erased and a second one written in its place). It has been found in many examples that the original writing could be read by the use of ultra-violet rays, and in this way some texts that had been thought completely lost have been recovered.

To start with, parchment was used in rolls like papyrus, and individual skins were sewn together to make longer rolls, but from the beginning of the 2nd century A.D. a new form of vellum book came into general use. This was called the *codex*. From quite early times the Greeks had used small writing tablets of wood with (or without) a thin surface of wax on which short notes or school exercises were scratched with a metal pen (*stylus*). Sometimes two or more such tablets were joined together with leather thongs, making a sort of a book. This served as a model when the use of vellum as writing material became more common.

Each piece of vellum, cut to size, was folded to make two leaves, and two, three, or four pieces so folded were fitted one inside another to make up a section or "gathering." The *codex* (pl. *codices*) usually consists of several such "gatherings" each with a definite number of leaves. Vellum continued to be used for books until paper was introduced into Europe in the 12th century.

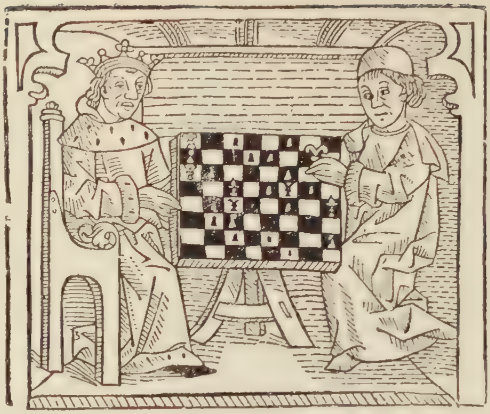
Up to the middle of the 15th century, when printing was invented, all books were written out by hand. When the Romans became rulers of the world they took over the traditions of the Greeks in the realm of books. The copying of the writings of classical Greek authors was carried on with great energy. For this purpose, booksellers (*bibliopolae*) employed specially qualified slaves (*servi literati*). At the downfall of the Roman Empire the collections of books which had been built up were nearly all destroyed. The Roman

British Museum, Harleian MS.

BEFORE THE PRINTING PRESS CAME

The production of books before the invention of movable type was laborious work. Much of it was done in the monasteries, for the great houses had "scriptoria" where the monks or scribes copied the author's manuscript. Above is a monk at work in a scriptorium.

Church, however, with its religious orders and institutions, carried on the bookish tradition. Among the religious orders the Benedictines, founded in 528 by Benedict, were especially concerned with books. Many of the monasteries devoted much time to the copying of manuscripts. In some the monks worked at desks in a room called the *scriptorium* (writing-room). In others, especially in earlier times, each monk worked in his own cell. Before beginning his writing, the scribe ruled lines with a pointed *stylus* or with red ink or with lead pencil. Writing was done at a steeply sloping desk, with a quill pen made from the feather of a large bird, *e.g.* a goose. The ink used was for a long time the same as that already mentioned for writing on papyrus, but from the 12th century onwards a new ink was used made from iron filings and oak-bark, or gall-nuts boiled in vinegar. The book to be copied would be held in a small stand attached to the writing desk. Sometimes the scribe wrote from dictation; sometimes, if a book was wanted in a hurry, the writing of the volume would be divided among several scribes.



A CAXTON ILLUSTRATION

The first English printer was William Caxton, who in 1476 set up his press in the precincts of Westminster Abbey. This woodcut is from the second edition of his book *The Game and Playe of Chesse*

Many of the manuscripts (see article) from the Middle Ages are richly decorated. At first it was customary for the first word to be given a large or coloured initial, later the first word of each part or chapter had its own decorated initial. Decoration came to be increasingly important and initials became the framework for complete pictures called miniatures—a word derived from *minium*, Latin word for red-lead used in the manufacture of the red colour seen in these pictures. The margins were also decorated. This illumination, as it was called, was as a rule done by an *illuminator*.

Among the earliest vellum *codices* which have come down to the 20th century are the Biblical manuscripts Codex Vaticanus and Codex Sinaiticus (both 4th century A.D.), and Codex Alexandrinus (5th century). The first of these is in the Vatican; the others are in the British Museum.

Codex Alexandrinus was so called because it was given to Charles I by the Patriarch of Alexandria in 1627, and Codex Sinaiticus because it was discovered in a monastery on Mount Sinai. Part of this manuscript was found in a basket of rubbish about to be burnt; it became the property of the tsar of Russia, and was sold to the British Museum in 1933.

By far the greatest number of medieval books were Bibles, missals, and other religious writings. Next in importance were books of law, medicine, and natural history, the works of Greek and Latin authors, and later chronicles and romances. Most of them were in Latin, but later some were in English, French, and other European languages.

About 1200 the universities began to play a part in the intellectual life of Europe. The production of manuscripts was no longer confined to the monasteries, but was also carried on by professional scribes who were recognized as university officials. Stationers (*stationarii*) kept in stock a number of copies of the texts required in the university courses and lent them, for payment, to students and teachers. As the universities increased in size, the provision of texts was more closely organized. University regulations specified that booksellers must not modify the text.

Before, or about the same time as, the invention of printing (see article) from movable types, about 1440, *block-books* had a fairly wide popularity. These were picture-books consisting of several pages of religious pictures with accompanying letterpress, each page printed from an engraved wood block. Block-books continued to have a wide circulation even after the invention of printing, owing to their cheapness and their pictorial appeal.

The early printers naturally modelled their books on manuscripts. It is easy at first glance to mis-

PRINTING BOOKS IN THE 16th CENTURY

These three woodcuts by Jost Amman, a Swiss or German engraver, who lived from 1539 to 1591, show how books were printed in the century immediately following the invention of printing. On the left, paper is being made with a pulping mill and a press. Next, the book is being printed with a hand-press. On the right a book is being bound: one man is sewing the sections together on a sewing frame, and the other is trimming the book edges in a press. At this time books were both rare and extremely expensive.

take many of the earliest printed books, including the famous Gutenberg Bible, printed *c.* 1455, for manuscripts. The style of type, the layout on the page, and the decoration were largely influenced by local manuscript style in the place where the printer was at work. Thus the type most common in Germany was Gothic, and that in Italy, the other main centre of early printing, Roman. In the abbreviations used and in other details the printed book also copied the manuscript: thus there was no title-page to begin with and the text started on the first page with the words *Hic Incipit* (Here begins . . .) just as the manuscripts had done. Blank spaces were left for the initials to be drawn in by hand and decorations were often painted in the margins. Printed illustrations were made from woodcuts.

The earliest printed books with printed illustrations were produced in Bavaria. This is not surprising, seeing that many woodcut pictures of saints and other religious subjects were common there in the late 15th century. These early illustrations were often crude and sometimes one illustration had to represent a number of different subjects—one figure serving for several different persons. Before long, however, great artists like Dürer and Holbein produced some beautiful book-illustrations. Since then many different methods of book-illustration have been used with great success: engraving, etching, lithography, mezzotint, aquatint. (*See* ENGRAVING; LITHOGRAPHY.)

When printing was first invented, a few of the great book-lovers in Italy refused to have any printed books in their possession. By the end of the 15th century, however, the printed book was firmly established in its own right, and it rapidly came to fulfil all the functions of the printed book as it is known to-day.

Manuscripts and printed books are usually provided with a protective covering called the binding (see second part of this article). The earliest-known decorated leather binding belongs to the 6th century A.D.; it was found in Egypt. Another book containing St. John's Gospel, found in the tomb of St. Cuthbert at Durham, has a remarkably well-preserved binding which may date from as early as the 7th century.

By 1550 the modern book had taken on its present-day form. It now begins with a "half-title," giving only a short or condensed title, followed by the title-page giving the full title, the name of the author, the name of the publisher and the city in which his business is situated, and (sometimes) the date of publication. On the reverse of the title may be placed the name of the printer, if, as frequently happens, the printer and the publisher are not the same person or firm.

Then may follow a page for a dedication, if there is one, after which often comes a preface or foreword stating the plan and purpose of the book. Books of informative character have an index following the body of the text. A bibliographical description of a book gives all this information in brief form. (*See* BIBLIOGRAPHY.)

Formerly the sizes of books were indicated by an abbreviation, such as 8vo or 12mo (standing for octavo and duodecimo). When all paper was made by hand, the size of the sheets did not vary very greatly. If a full sheet was folded to make two leaves of four pages, it was said to be in folio; folded into four leaves, it was in quarto (4to); if eight leaves, it was octavo (8vo); and so on to 64mo and 128mo.

Nowadays these sizes are used much more rarely. Paper is made in long rolls by machine and much larger sizes are usual in printing. The sizes of paper commonly used with the size of an octavo paper produced by these are as follows: Foolscap, $6\frac{3}{4}'' \times 4\frac{1}{4}''$; Crown, $7\frac{1}{2}'' \times 5''$; Demy, $8\frac{3}{4}'' \times 5\frac{5}{8}''$; Royal, $10'' \times 6\frac{1}{4}''$.

HOW A MODERN BOOK IS MADE

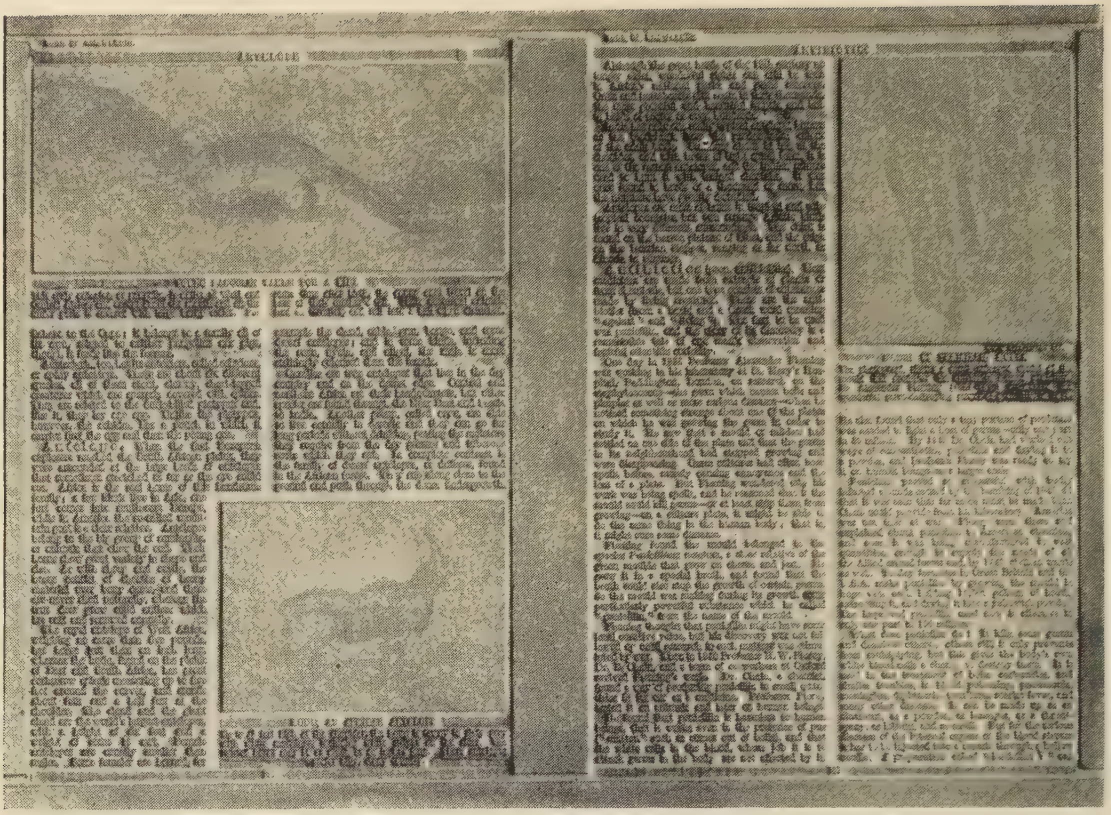
When a publisher plans to issue a new book he must consider many matters—size in relation to subject, the kind of paper, and size and face of type. Some type faces print well on rough paper, others best on smooth. Also, in a book like a novel, which is likely to be read for long periods at a time, the ease of reading of the particular type has to be considered. The kind of book even influences the size of the printed area on a page. A novel is held in the hand, so there must be wide margins at the outside (fore-edge) and bottom (tail) edges to give an easy grip without hiding part of the reading matter with finger and thumb. A heavy book of reference is generally laid flat for reading, and it can have smaller margins. Therefore, from a dummy copy, the publisher can judge the appearance and the cost, and decide if it is within the price he can charge for the finished book.

The printer is then told the style and size of type he has to use, and the chosen size and quality of the paper.

The manuscript is set up into metal type. This work is called *composing*—a highly skilled job demanding great accuracy. The man who does it is called a *compositor*. Composing for books is generally done on machines which cast the metal type ready for use. A Monotype (see article) machine casts single letters or characters. A Linotype (see article) or an Intertype machine casts a series of letters or words in one length. This series is generally as wide as the column and is called a *slug*. All three machines have keyboards somewhat like that of a typewriter.

The type is set on any of the three machines in a long column. *Galley proofs*, as they are called, are then printed on long strips of paper so that the printer's reader, the sub-editor, and the author may correct errors before the type is made up into pages.

The number of pages in each *section* must now be fixed. It is generally 16 or 32, or even 64, depending on the thickness of the paper; odd sections, and those printed on special papers or by special processes, may consist of only four or eight pages. Whatever the number of pages decided upon, the printer will use the largest sheet of paper he can get on his machine, as this will save him money. Later in this article you will see why it is necessary to make up pages into sections.



1. FACE OF A PAPIER MÂCHÉ MOULD

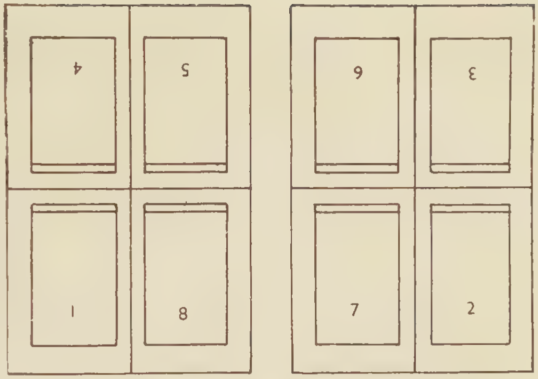
To avoid having to print from type and original photo-engravings, and also to make each page easy to handle and to store, if necessary, the printer uses a thin printing plate. A mould of the page is taken in damp papier mâché (which the publishing trade calls flong), and the plate is obtained by pouring molten metal on to it. This illustration is the mould of pages 168 and 169 in Volume I of the present edition of THE BOOK OF KNOWLEDGE.

The next step is to arrange the type and illustrations to fit the size of page decided by the publisher. The type and other matter is fixed tightly in the correct position in a small steel frame called a *chase*. It would then print exactly the matter required for the particular page. To print direct from the metal type and illustrations (made by a method called photo-engraving), where the number of copies to be printed is large, is nowadays very unusual. The printer would not risk damage to type; a loose or misplaced piece of type would spoil much of the work, and a damaged illustration would have to be re-made. In addition, it may be necessary to print the same set of pages on two machines. So the printer uses easily-handled copies of the pages in the form of thin metal plates called *stereos*.

He does this by first making a mould of the type in damp papier mâché (fig. 1). When this is dry it can be used to cast stereos. These can be made also of rubber and of a plastic similar to that used in making a telephone instrument. The majority of books are printed from metal stereos, although the rubber and plastic ones are being used more and more. Duplicate plates can also be made by a process of electroplating, the resulting plate being called an electrotype. Improvements in stereotyping have deprived the electrotype of some of the value which at one time it possessed.

Thus, for each page a thin printing plate is made. These plates have now to be fixed on either a board or metal bed or in a steel frame, and placed in the correct position on the printing machine. The position of each page as it will be printed on the sheets of paper depends on the number of pages to be printed on the sheet. Careful planning is necessary because, when the large sheet is folded, the pages must come out in the proper order. Fig. 2 shows how this is done for an 8-page sheet. It is more difficult to arrange for a 16- or 32-page sheet; while a 64-page sheet requires very special arrangement. It generally has 32 pages on one side, and the backs of these on the other. The sheet is printed on one side and then turned over and fed into the machine again. it is then cut across in half to give two sheets of 32 pages. The arrangement of the plates on the beds is called a *forme*, and a typical forme is shown in fig. 5. Apart from the order of the plates, the greatest possible care has to be exercised in getting them exactly in position so that the printed area of the front of a page corresponds exactly with the printed area on the back. Otherwise, facing pages will not line up together, and the resulting uneven margins will spoil the appearance of the work. This part of the preparation is called *imposition*, and is very skilled work.

Book printing is generally done on a " flat bed "



2. METHOD OF IMPOSITION

One side of the paper is printed with one forme, the other side with a second forme. When the paper is folded, it makes up one complete section of eight pages.

machine (fig. 4). The forme containing the plates is placed on the bed of the machine, which moves backwards and forwards, first under a series of rollers that ink the surface of the printing plates, and then under a revolving cylinder round which the sheet of paper is carried. The paper comes in contact with the inked plates and receives its print. It is then released from the cylinder and carried away on moving tapes to a pile at the back of the machine. When the ink is sufficiently dry to be rub-proof, the other side of the sheet can be printed. The feeding of the paper to the cylinder of the machine is done mechanically. Modern machines work extremely quickly, and it is quite usual to pass 2,500 sheets per hour through the machine (fig. 5).

When the sheets are dry, the next operation is folding and, if necessary, cutting. The folding is done on a machine which, by means of blunt knives, makes up a small booklet of the set number of pages. Each booklet is known as a *section*. If two sections are folded together and have to be separated, this is done by a sharp revolving disc.

The different sections are then gathered together in their proper order to make up the book. This *gathering* must be carefully done, generally by a machine in which moving arms pick up the sections in proper order and place them together on a travelling band. To keep the right order there is an identifying mark on the first page of each section, called a *signature*, and this is the binder's guide. Sometimes another method of marking signatures is used. A black stroke is printed between the first and last pages of a section. When the sheet is folded, this stroke shows on the back fold of the section. Each section has its mark in a different position, and when the sections are gathered together it can easily be seen if they are in the proper order (fig. 6).

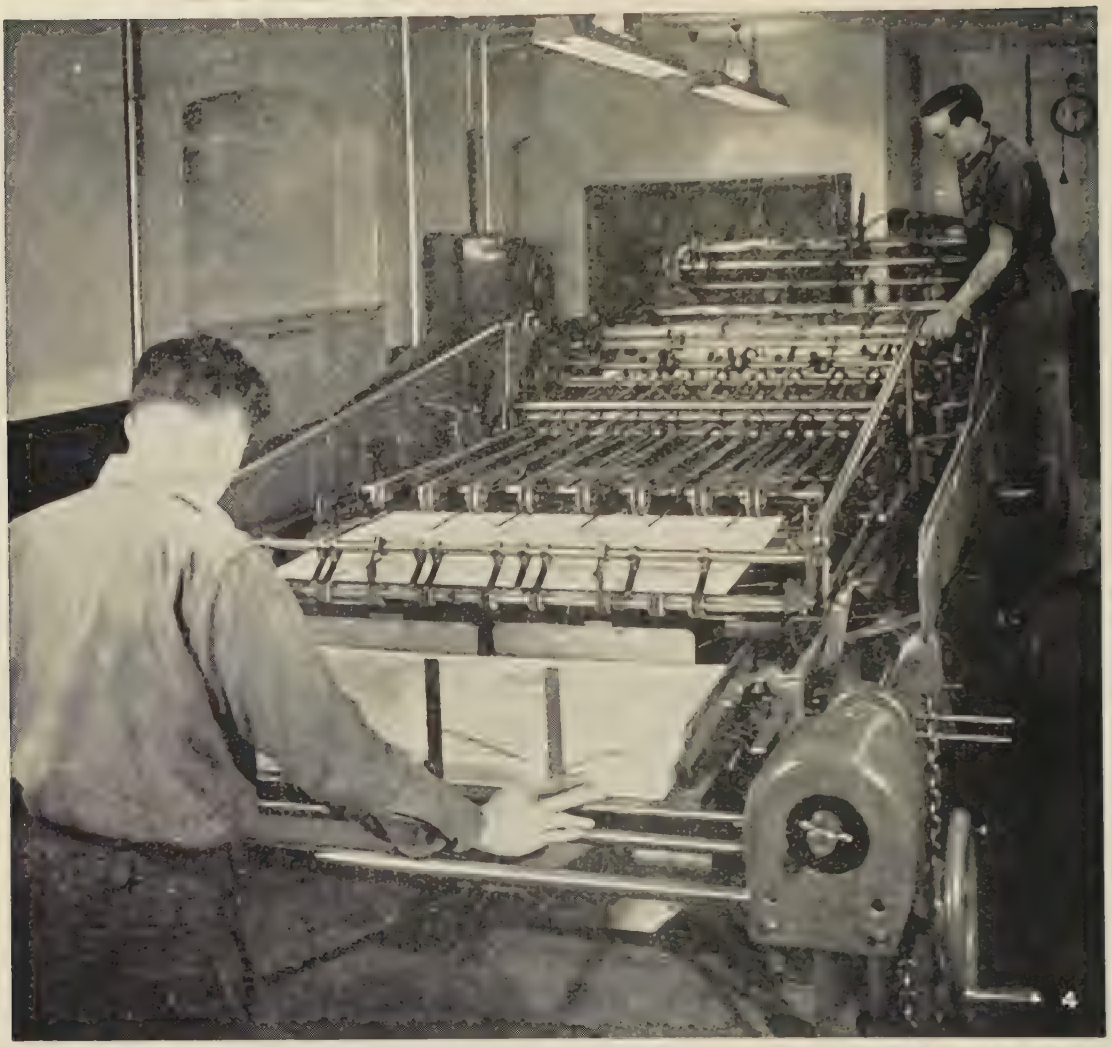
The gathered sections are then ready for *sewing*, carried out by machine. The operator places each section under the battery of needles in the proper order. The sheets of each section are sewn together and the sewing is carried on to the next section, thus joining the sections.

The book is now sewn but the back folds of the sections are loose and open and many of the page edges are uncut. The back is therefore compressed, or *smashed*, in a press, while the page edges are cut to size in a machine called a *guillotine*. The book is now taking shape; but in its present form it would soon fall to pieces, and so the back has to be protected by gluing the sections together with a flexible glue

3. STEREOTYPER HOLDING A MOULD

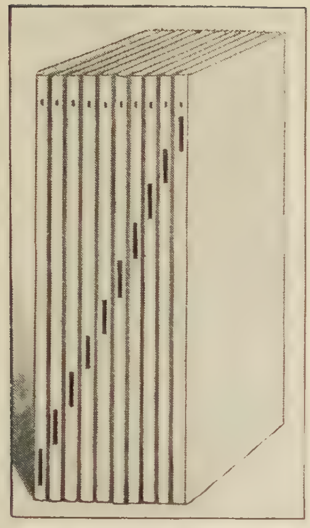
This stereotyper is holding a mould made by pressing damp papier mâché under great pressure on to a forme (a page or pages locked together) of type and illustrations, such as can be seen to the right of the stereotyper. THE BOOK OF KNOWLEDGE required eight moulds to make plates for its sections of 16 pages.

FLAT-BED PRINTING PRESSES IN ACTION



Top photo, Linotype and Machinery Ltd.

The forme containing the plates moves backwards and forwards under rollers which ink the surface of the printing plates, and then passes under a revolving cylinder round which a sheet of paper is carried. The paper comes in contact with the inked plates ; receives its prints ; and is then released from the cylinder and carried to the end of the machine. In the upper picture the machine-minder is seen carefully looking over the printed sheets.



6. ALL IN ORDER

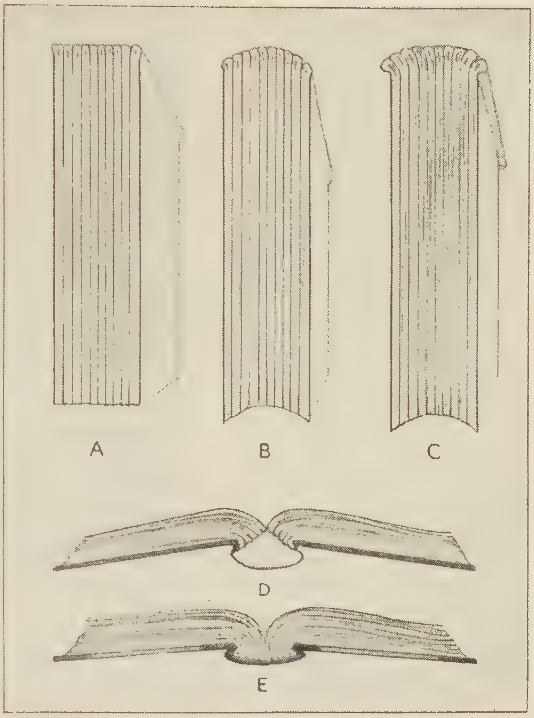
A missing or misplaced section would be noted at a glance by the binder if a black step were out of its due order or absent.

This is done in a machine with a revolving brush which forces the glue into the folds and into some of the sewing threads. A press holds the book while setting takes place.

But a book with a firmly glued flat back would not open easily. It has therefore to be shaped at the back, and a groove made so that the cover and pages will hinge easily. This is called *rounding and backing*. It is done with heavy rollers and pressure in a machine (see Fig. 7).

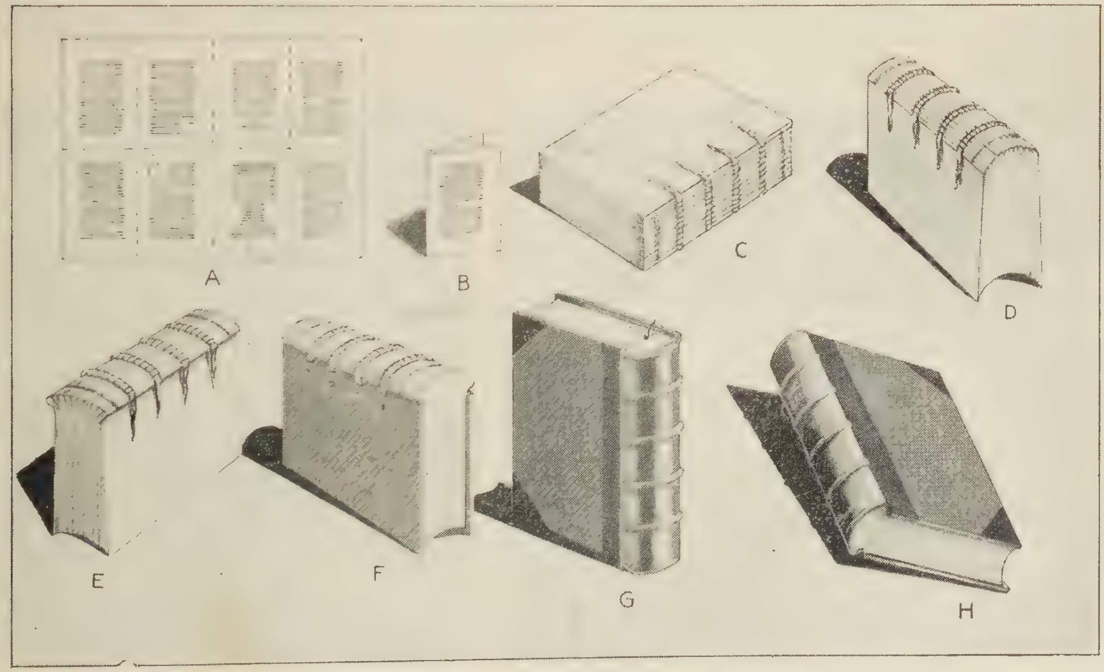
It will be seen how the operation makes the book easy to handle. Afterwards, the back of the book is again glued, and a wide strip of muslin with overhanging edges is glued on. These overhanging edges are later to be glued to the sides of the binding, and serve to strengthen the book.

The body of the book has now to be fitted into a *case* or binding. A case is simply a sheet of cloth, paper, or leather strengthened with two boards



7. WHY A BOOK OPENS EASILY

A shows a book before rounding ; B shows it after rounding. C shows a book after rounding and backing. The book at D is secured by the end-papers, which are glued to the cover ; finally, that at E has been sewn.



8. FROM PRINTED SHEET TO BOUND VOLUME.

The printed sheet (A) is folded (B), and the sections, called signatures, are placed in order. The gathered sections are sewn (C), and the book is shaped at the back (D), and a groove made so that the cover and pages will hinge easily (E). The body of the volume is fitted into a case or binding. A case (G) is a sheet of cloth, paper, or leather strengthened with two boards (F), and lined with strong paper inside the back. Finally the book is pressed flat (H).

and with a lining of strong paper inside the back or *spine*. Cases are made in an ingenious machine which gathers the boards, places them on the glued cloth exactly in position, and turns the edges of the cloth over the edges of the boards to give a neat edge. Lettering is done in a heavy press, from brass dies, or letters, using gold leaf or ink. The fitting of the body of the book into the case is done by a machine which takes up an empty case, pastes the inside boards, fixes the body of the book in position and then smooths down the muslin and the outside sheets, called *end-papers*, so that everything is safely anchored in place. The books are then piled between boards in a press, where they remain until they are perfectly dry and flat (fig. 8).

This is the making of a hollow-backed book. Some books are bound with a solid back to which a suitable cover is glued. The cover may be paper, cloth, or leather, according to the type and value of the book. Some Bibles and hymn books are so bound. In France the majority of books are so bound in paper covers.

The book is now ready for sale, but it needs protection when being handled in the bookshop. So most publishers provide printed paper jackets which serve the double purpose of protection and of attracting the buyer.

HANDWORK IN BOOKBINDING

This example of the bookbinder's art is from the library of a noted French collector, Jean Grolier, Vicomte d'Aguisy (1479-1565), in a style of binding named after him.

So far a machine-made, or *edition*, binding has been described. Many books of a special value are printed in very small editions, and often very expensively, so that they must be bound by hand. The steps are similar to those of machine binding and are shown in fig. 8. Sewing is done by hand, the threads which go along the back of each section being fixed, for additional strength, to cords or tapes held taut in a sewing frame (fig. 9). Rounding and backing is done by gently hammering the back while the body of the book is held in a press. The value of the book greatly affects the type of case used. Some library books which have been rebound because of wear are cased in very simple material. Valuable books give play to the artistic skill of the craftsman. Often the edges of the book are gilded in real gold leaf. Many bindings are made of beautifully decorated leather or vellum.

Consider the development of hand binding. In the early centuries before the invention of printing, books were usually written on vellum, the sheets of which were sewn together. Use and wear made it necessary to protect the sheets by

9 and 10. SEWING SECTIONS AND FINISHING A BINDING

Though sections are usually sewn by machinery, certain works of special value are still hand-sewn (left). The operator is facing half-right with the left hand behind the section ready to receive the needle. Leather stamped in gilt is the material for fine bindings, and in the right-hand illustration a craftsman is putting the finishing touches to a hand-bound volume. The value of the book greatly affects the type of case used, and the amount of work put into it.

sewing on wooden sides. Attaching a back of leather was the next natural step, and so the full case came into being. The covering of the wooden sides with leather was a later development, and the craftsmen used their artistic taste and craft to decorate such surfaces. This was done by impressing heated tools, engraved irons, and rollers into the leather. To this day there are a few craftsmen who carry out such work. Many are the designs, and these workers ornament their outlines with gold leaf (fig. 10), palladium leaf, coloured enamels, and in other ways. The craftsmen of to-day make special bindings for rare books or for presentation copies. Their designs reflect modern ideas and taste.

In earlier days the leathers used in Britain were made from the skins of native animals, mainly calf and deer. On the Continent the leathers of Spain and Morocco were used. These were generally of goatskin, and they had a grain surface characteristic of this skin. Hence the leather got the name morocco. Sheepskins from the Levant had a softer and looser grain surface, and these leathers became known as levant. Russia leather was made from calf skins, and had a characteristic odour derived from the birch bark used in tanning.

Nowadays any grain surface can be imitated by printing leather with embossed plates, and the leather is chemically treated to prevent rotting.

HOW TO KEEP SIMPLE ACCOUNTS

Book-keeping. Far more people now than formerly are earning money beyond what they require for their daily needs. A household where several adults are working may well be earning £30 and upwards a week. But do they know how they stand, and whether they are making the best use of their money for enjoyment in the present and as provision against the future? That can be achieved easily if they appoint one member of the family to administer the surplus that remains after each has deducted his or her essential outgoings. To do this effectively involves keeping accounts, which means understanding "book-keeping."

Book-keeping to many sounds complicated and hard, but simple accounting is not difficult. The drawing of lines to enclose simple entries of expenses and receipts is just an aid to the picture one wishes to make—what is being done with the money; where it "goes," as the saying is.

The simpler methods are so plain and helpful that they can be mastered with less difficulty than most card games. Adding a second or third book or page, to which the entries are made in a different form, is simply adding another player, or rather an umpire, who keeps the players playing the game correctly and decides doubtful points.

The leading forms of accounts are (1) an account of money received and spent, called a *cash account;* (2) an account of *indebtedness,* where money is owed by one person or firm to another.

A *cash account* can be kept on the opposite pages of a book, as shown in Fig. 1; or it can be kept on one page containing double sets of columns, as shown in Fig. 2.

If a cash account is kept on opposite pages,

(Year)		Received	£ s. d.	(Year)		Paid	£ s. d.
Mar.	1	From sale of tickets	20 0 0	Mar.	2	K. Ryder for printing	10 10 0
,,	2	From Mr. Whitney as gift	3 0 0	,,	3	Telephone calls	11 4
,,	15	From proceeds of dance	2 7 6	,,	16	Equipment from S. H. Smith & Co.	3 2 0
,,	17	Subscriptions	4 2 6	,,	28	Travel expenses	1 13 6
						Balance in hand	13 13 2
		Total	£29 10 0			Total	£29 10 0

1: Cash Account of a Football Club

(Year)			Dr. £ s. d.	Cr. £ s. d.
Mar.	1	Received from sale of tickets	20 0 0	
,,	2	Received as gift from Mr. Whitney	3 0 0	
,,	2	Paid K. Ryder & Co. for printing		10 10 0
,,	3	Paid telephone calls		11 4
,,	15	Received from proceeds of dance	2 7 6	
,,	16	Paid S. H. Smith & Co. for equipment		3 2 0
,,	17	Subscriptions	4 2 6	
,,	28	Travel expenses		1 13 6
		Balance in hand		13 13 2
			£29 10 0	£29 10 0

2: Cash Account of a Football Club

Dr. (Year)		Cash	£	s.	d.	Cr. (Year)		Cash	£	s.	d.
Aug.	1	Balance brought forward	3	2	0	Aug.	1	August rent	10	0	0
,,	1	Monthly allocation from family	60	0	0	,,	1	Henshaw Dairy for milk	2	11	9
						,,	1	Wordman for groceries	12	9	9
						,,	7	Porter's for meat, etc.	9	18	6
						,,	15	TV and washing machine (instalments)	5	0	0
						,,	15	Savings and Premium Bond purchases	10	0	0
						,,	17	Fuel for use and store	2	3	8
						,,	30	Telephone (estimated proportion for month)	2	0	0
						,,	30	Electricity (ditto)	1	15	0
						,,	30	Gas (ditto)	1	18	0
								Balance in hand	5	5	4
		Total	£63	2	0			Total	£63	2	0

3 : Household Cash Account (or Family Budget)

MRS. GEORGE PARKER
28, Winter Hill

Dr.			£	s.	d.	Cr.			£	s.	d.
Jan.	1	1 Blouse	4	4	0	Jan.	9	2 Yds. Silk @ £2 10s.	5	0	0
,,	8	1 Pr. Gloves	1	15	0	Feb.	3	Cash	13	2	6
,,	8	2 Yds. Silk @ £2 10s.	5	0	0						
,,	15	1 Dress	6	6	0						
,,	18	10 Yds. Trimming @ 1s.9d.		17	6						
			£18	2	6				£18	2	6

4 : An Account of Indebtedness

the word *Cash* is written at the top of each page. On the left-hand page, under the word *Received*, or under the abbreviation *Dr.* (debtor), are written the sums of money received as cash, or in the form of cheques, drafts, money orders, etc. On the right-hand page under the word *Paid*, or under the abbreviation *Cr.* (creditor), are written all sums of money paid out. The left-hand side is known as the *debit*, the right-hand side as the *credit*, side of the account.

Fig. 1 is a month's cash account kept in this way by the treasurer of a football club.

If you add the sum of money in hand (called the *balance in hand*) to that paid out, the total for the two columns in a cash account should be the same. If the totals are different there has been an item omitted, or some other mistake made.

Writing in the totals in an account is called *balancing* it. A cash account can be balanced daily or weekly, or at any other stated time.

Fig. 2 is the same account as Fig. 1, but with the items all entered as they occurred on a single page containing one column labelled *Dr.* for cash received and one column labelled *Cr.* for cash paid out.

Fig. 3 shows what might be a household account like the one mentioned in the opening paragraph. It is similar in form to that given first for the football club, but in place of the word *Received* the abbreviation *Dr.* is used, and in place of *Paid*, *Cr.* It should be noted that an estimated monthly proportion has been set aside to cover the household's expenditure on telephone, light, etc., so as to avoid any embarrassment when the accounts are rendered quarterly or six-monthly.

In keeping an account of *indebtedness*, a book is used called a *ledger*. The name of the person owing money is written with his or her address on the lines above the account. At the left, on the *debit* side of the account, are written the items for which the person is in debt. At the right, on the *credit* side of the account, are written all sums of money he has paid and the value of goods or service for which he should receive credit.

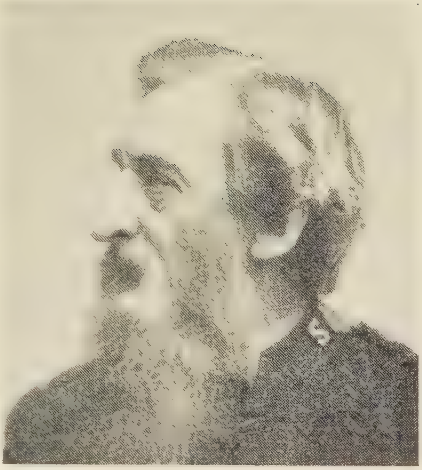
The account in Fig. 4 shows that Mrs. George Parker, of 28, Winter Hill, during the month of January bought, from the firm keeping the account, goods costing her £18 2s. 6d., and that she had returned silk for which she was credited £5 and that she paid on the bill £13 2s. 6d. in cash.

The accounts kept by business men depend upon the nature of their business. If the business is buying and selling on a small scale, the transactions are usually first written, as they occur, in a book called a *day book*, or the record is kept on *sales slips*. These items are transferred to a ledger in the form of a book, or to a set of ledger cards, kept in a box.

When the business is more complicated, such as that conducted by a big wholesale firm or by a factory, the accounts are much more elaborate. All transactions are recorded in at least two

accounts, so that they occur on the *debit* side of one account and on the *credit* side of another. Such a system is called *double entry*, in distinction from single entry, where each item occurs on only one side of an account. This more elaborate form of book-keeping allows of more careful checking.

Just as a professional engineer represents a higher stage than a mechanic, so an expert accountant is more highly trained than a book-keeper. Accountancy is a recognized profession, and to become a qualified accountant it is necessary to pass the examinations of the Institute of Chartered Accountants, or other recognized bodies—which takes years of hard study.



GENERAL BOOTH

In 1865 William Booth started the East London Revival Society which became the Salvation Army, with himself as its "General."

Boomerang. One day, hundreds of years ago, a hungry Australian aboriginal threw the curved branch of a tree at an emu chick to kill it. He missed, but to his surprise the branch flew back to fall at his feet.

That set him thinking, and when he picked up the stick to examine it he found that it was flat on one side and rounded on the other. He tried throwing it again, but it was only after long practice that he could do the trick a second time. Soon the news got about and all the tribesmen began throwing curved sticks, but none flew back.

Then someone tried carving a stick into the shape of a curved branch and found that it worked. Thus the Australian boomerang was invented ; and a remarkable invention it was for people who were so primitive that they could not count beyond the fingers of their two hands.

By the time the first white men arrived in Australia every aboriginal was able to perform remarkable feats with the boomerang. This missile is made of hard wood bent to a curve over a fire, or cut direct from a curved or forked bough or tree trunk. It is from two to four feet long, rounded on one side and flat on the other and with a sharp edge. When thrown, it slowly rises in the air, whirling round and round in a curved line until it reaches a height of several yards, when it begins to fly back again and sweeps over the head of the thrower to fall behind him. Sometimes the boomerang is thrown in such a way that on its way it will bound off the ground two or three times, much as a flat stone bounds forward when thrown along the surface of water (see diagram). The surprising motion of the missile is due to the action of the air on the bulging side of the curved wood.

THE RETURN OF THE BOOMERANG

One of the hunting weapons of the Australian aborigines is the boomerang, a thin curved piece of hard wood, flat on one side and rounded on the other. Here the boomerang has struck the ground from 15 to 20 yards from the thrower, ricochetted twice, and returned.

There are two types of boomerang, the return kind, which is used only for sport, and the war or hunting boomerang. The latter does not return, but it can be used to strike an object behind the thrower. An expert can throw a boomerang to kill an animal 400 feet away.

Booth, William (1829–1912). "He was not, like most people, intent upon some subjects and languid on others. He had the power of throwing himself into this or that subject, whatever it might be. It was more than mere passion and energy—it was a great overflowing intensity." That was how William Bramwell Booth explained the secret of his father's extraordinary success.

William Booth, founder of the Salvation Army, was born at Nottingham on April 10, 1829, and was very poor for the first few years of his life. He developed a passion for open-air preaching when quite young, and after working for the Wesleyan Methodists and the Methodist New Connexion, he began on his own account as an evangelist in East London in 1865 among the very poor, using the most unconventional methods. He started the East London Revival Society, which became the Salvation Army, using real army ranks, with himself as its "General." In all his work he was helped by his wife, Catherine Mumford (1829–90), whom he had married in 1855. He was succeeded as General of the Salvation Army by his son, William Bramwell Booth (1856–1929) ; and his fourth daughter, Evangeline (1865–1950), after being National Commander in the United States from 1904, was General from 1934 to 1946.

The religious organization General Booth founded did not seek to educate or train character along hard and fast lines, but to save those whom the churches failed to reach, and he relied quite as much on material help as on spiritual means for his conversions. He was not afraid of ridicule. "Why," he asked, "should the devil have all the good tunes ? " and he had hymns sung to popular music-hall airs. The Army, now a world-wide organization, campaigns in quasi-military style, with officers, uniforms, flags, and bands, against sin and evil, especially among the poor, and houses many of the homeless. General Booth lived to see the great value of his work acknowledged even by those who disliked his methods. To-day Salvation Army officers preach in many lands and in more than 100 languages. (*See* Salvation Army.)

FOOTWEAR DOWN THE AGES

Boots and Shoes. Man's use of footwear probably dates back at least 30,000 years. But although cave drawings and objects discovered within the last century entitle us to credit Ice Age Man with artistic achievements of considerable power and beauty, and with the use of clothing, it is unlikely that he wore on his feet anything resembling modern shoes. Protection against intense cold was probably his first care, and this he may have achieved by binding around his feet a sort of " bag " composed of the skin of an animal with the hairy side inwards. As the earth grew warmer, sandals may have developed as a protection against hot sand. Egyptian sandals certainly existed in 3000 B.C., and later the Greeks and Romans had a variety of decorated sandals. Some Roman styles (as may be seen in the leather section of the Guildhall Museum) approach the modern shoe form. Moccasins and soft skin boots are still used by American Indians and Eskimos. The sabot, or wooden shoe cut out of a solid block, is still worn by workers in the Low Countries, France, and other parts of Europe, but the use of wooden " clogs " by mill-workers in the north of England is now becoming rare.

Modern footwear is of quite recent development, dating only from the 17th century. Most medieval footwear, including the long, narrow-toed styles of the 13th and 14th centuries, was relatively flimsy. The high leather boots which were fashioned as protection to the leg after men-at-arms ceased to wear full armour were of soft leather. Heels proper were not known before the time of Elizabeth I, though " wedge " heels were known earlier. The demands of the Cromwellian armies for stronger footwear which would stand up to their campaigning are supposed to have played some considerable part in the development of the modern boot or shoe ; and its value in gripping a stirrup may have helped to popularise the heel.

Roman and much of medieval footwear was distinctly made in pairs, but the " duck-bill " and " horn-toed " shoes which fashion decreed to follow the long-pointed model, and which were in use until the 17th century, were made to fit either foot. Until the 17th century most footwear had no " sole " in the modern sense. Bottom and upper, both of soft leather, were sewn together and then turned. An in-sole was then added. Thick-soled boots and shoes were another development from the campaigns of the English Civil War.

SANDALS OF ROMAN STYLE

These two Roman sandals, which once trod London's streets in the days when Britain was a province of Rome, were dug up in a deposit of peat in the Moorgate district of the City of London.

Little scientific attention was paid to foot comfort until quite recent days, and many elderly people have misshapen toes through wearing ill-fitting shoes in childhood. Nowadays the suitability of every boot or shoe for the structure of any particular foot is carefully considered both by the makers and by the fitters, even to the extent of using X-ray apparatus to ensure a correct fit.

In the early days of the bootmaking business one man did all the work on a pair of boots. Later bootmakers with a reputation for making especially good footwear found that they could profitably employ others to do certain parts of the work for them, and one man would give all his time to cutting out and stitching uppers, another to putting on soles, a third to fixing heels, and so on.

That was the beginning of the " factory system " in the boot industry, and it was followed by the introduction of machinery in the first half of the 19th century. In a modern boot factory there are a great number of distinct processes, taken care of by as many different machines. Machinery makes a uniform product at a greatly increased rate of output. By expert hand work each man employed could produce one pair of boots a day. With machinery it is now possible to complete a pair of boots every fifteen minutes.

Before the days of machinery the shoemaker put the sole leather over a lapstone (*i.e.* a stone held between the knees) and pounded it with a hammer to make it smoother and more durable. A " roller " machine to roll and press the leather was one of the first machines to come into general use. In hand work the pattern for the parts of the boot was laid out on the leather and the pieces were cut out with a sharp knife, one by one. Now dies are operated by machine, stamping out a number of similar pieces at one stroke. Cloth linings are cut several at a time by bandsaws.

Sewing-machines were first adapted for sewing the seams in the linings and uppers, and they are now used for sewing the upper to the sole.

The making of a pair of boots or shoes in a modern factory begins in the stock-room where materials of the proper qualities are stored. Uppers are cut from light cattle-hides, calfskins, sheepskins, goat-skins, kidskins, lizard skins, snakeskins, or from fabrics such as canvas, silk, or cloth. But for both soles and uppers the most important and satisfactory material is leather. It is easily cut, joined, moulded, and decorated ; and unlike rubber and plastics, it

HOW OUR ANCESTORS THROUGH THE AGES WERE SHOD

The late Egyptian sandal (1) is held in place by an anklet and straps. The Etruscan or Greek sandal (2) has more elaborate fastenings. The shoe of 1339 (3) has little to distinguish it from a slipper of to-day ; it is, in fact, more modern in form than the 16th-century shoe (4). The modern boot is suggested by the 10th-century Saxon example (5). The long boot (6) is of the time of Henry VI. In the reign of Charles II a wide-spreading top characterised men's boots (7). Queen Elizabeth's riding boot (8) was laced. The Cromwellian boot (9). The Chopine, worn by fashionable women in the 16th and early 17th centuries (10) was made of wood and cork, covered with leather. Of the early Irish brogues (11-13) one (11) has a sole ; (12, 13) is made in one piece.

" breathes," so giving good ventilation to the shoe and making it both healthier and more comfortable to wear. Leather soles are almost invariably made of heavy cow-hide.

The leather is put through a rolling machine and then through a stripping machine, which makes it of uniform thickness. Then it is sent to the cutting room, where the cutting presses stamp out the required number of parts by means of hides made up for this particular order. A " skiving " machine trims down the edges of the pieces to a neat bevelled edge, and another machine folds over and pounds down any edge that will show on the outside of the boot.

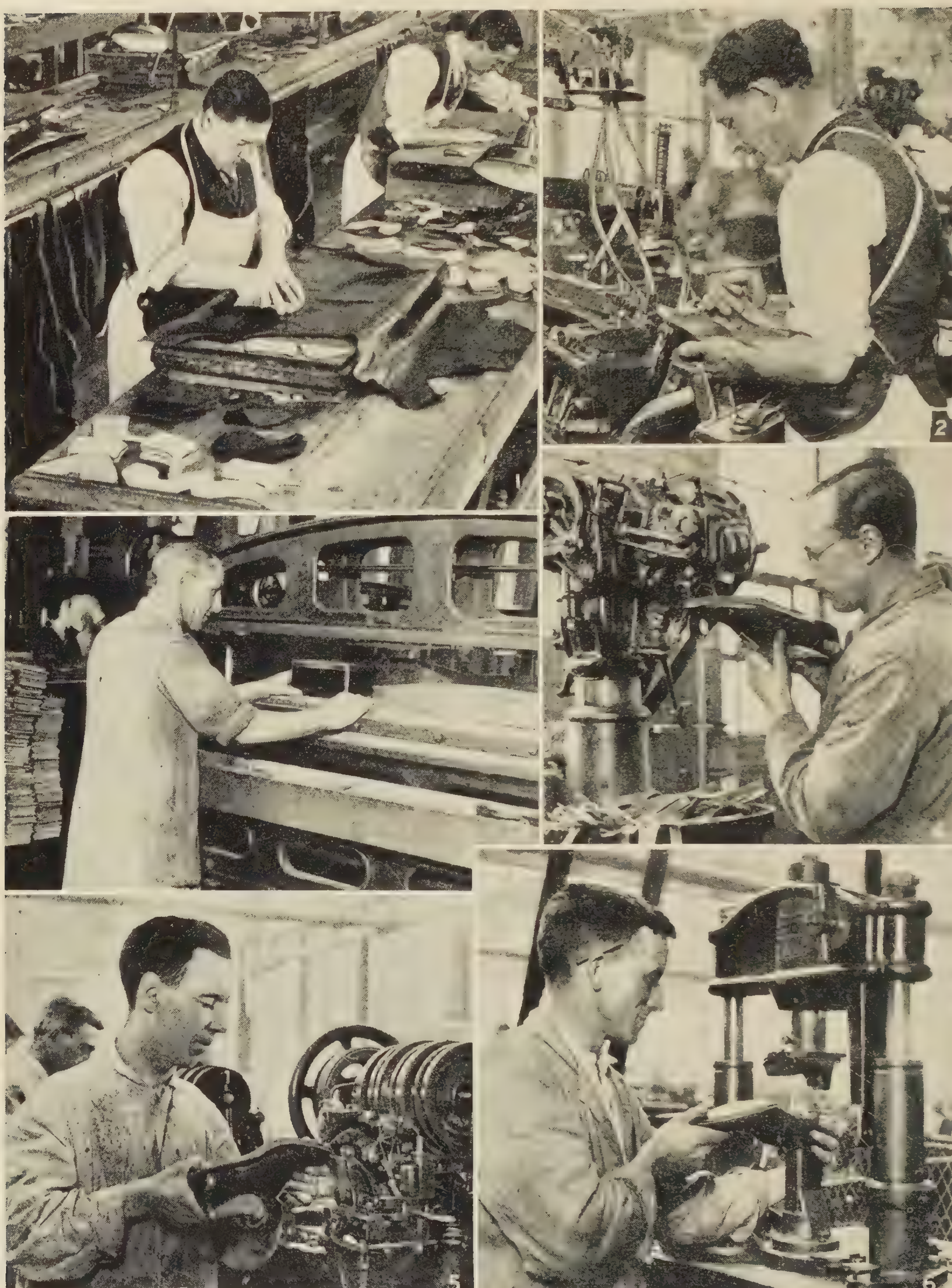
The uppers, with their linings, are sent to the sewing room. Here they pass down the line of machines, each operator sewing one kind of seam, until the uppers are lined and ready for the sole. Machines then stamp the metal eyelets in the lace-holes. Meanwhile the soles are cut, put through a splitting machine, and pressed, emerging with uniform thickness, smooth finish, correctly shaped, and ready for sewing to the uppers.

The boot is put together on a last, which is a wooden " foot " the same size and shape as the human foot to be fitted. Workmen put the upper on the last, with the toe and heel stiffening in place, and little more is required to be done by hand. Thereafter almost all that the workmen do is to pass the boot from one machine to another.

Some of the most important machines are used in these remaining stages of the work. The lacing machine quickly laces the upper together to hold the sides in proper relation to each other. On the pulling-over machine iron fingers grip the upper and the lining, and pull them down evenly over the last, where they are held by tacks. The lasting machine smooths out all the wrinkles in the upper and tacks it in place. Soles are sewed to the uppers with a stitching machine or a welt-sewing machine. The sole is fastened to the bottom of the last, and the upper drawn over, with its edges reaching round to the edges of the in-sole. A narrow strip called the welt is fastened below these, and the outer sole is then sewed to the welt.

The shoe is now ready for heeling, and this is done on the lightning heeling-machine, so called from the speed with which it works. The heels are built up of different strips of leather, cemented together and pressed. Then machines grind the heel, and the surface is smoothed with sandpapering and buffing machines.

LEATHER BOOTS AND SHOES IN THE MAKING



W. Barratt & Co., Ltd.

After being put through a rolling and then a stripping machine to make it of uniform thickness, the leather for the uppers is shaped by knives or dies (1). In (2) a worker is pulling uppers into shape for attachment to the soles ; a wooden "foot," or last, is used in this process. The soles, made of cowhide, are cut out (3), split, pressed, and shaped for sewing to the uppers. A narrow strip of leather, called a welt, is fastened below the edges of the in-sole (4). The sole is then stitched to the upper (5), and the heel fixed on (6).

Guildhall Museum, London

LEATHER FOOTWEAR OF ROMAN LONDON

These sandals and shoes, which were dug up on the site of Roman London, do not differ greatly from the footwear of to-day, except that the shoes have no heels. When the Roman army came to Britain they were wearing the *calceus*, which enclosed the foot and ankle in leather and met the lower edge of the shin armour.

The shoes, with the soles and heels attached, are then sent into the finishing room. There the soles are smoothed and polished; the uppers, the sides of the heels, and the edges of the soles are also blackened, browned, or otherwise coloured, and polished; the trade-mark of the manufacturer is stamped on the sole, and the size of the boot or shoe stamped on the instep.

Many shoes now have crêpe rubber soles. Raw rubber is passed through rollers until it comes out as a thin ribbon 16 feet long, 18 inches wide, and 1/64 inch thick, with a smooth surface and almost pure white in colour. A number of ribbons are laid one on top of the other and hammered and rolled until a solid length of rubber of the required thickness is produced. The rubber is then passed through another set of grooved rollers to give the ridged or corrugated surface characteristic of crêpe soles. The strip is next cut into 36-inch lengths 13 inches wide, and from this the sole and heel are cut in one piece and attached to the upper by a rubber adhesive or glue, and then stitched. The raised part of the heel is made from a piece of crêpe rubber which is heated and then pressed on to the rubber already there. Heating makes it somewhat sticky, so that when it dries it glues itself on without any need for stitching.

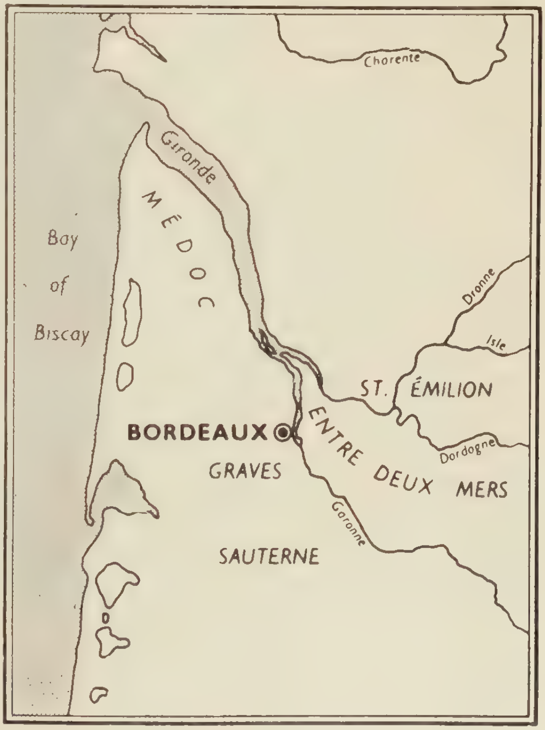
Crêpe rubber is slightly porous, that is, it allows air to circulate through it, so the inside of the shoe does not become too hot when worn. It is lighter than leather, is very flexible (easily bent) when the wearer is walking, and is absolutely waterproof.

Stitching has always been the weakest part of a shoe, as the movement of the foot when walking may slacken it or widen the thread holes. Improvements in machinery may exercise their effects upon traditional methods of bootmaking, as in other industries. One of the newer processes involves the attachment of a rubber sole to a leather upper by vulcanisation. This process, which saves some thirty operations, was first used with children's footwear and later carried out successfully with heavy working boots. Translucent plastic heels can, by a new method of heel attachment, be fixed to smart fashion shoes without the use of the conventional heel pins or screws. A machine now exists for the injection moulding of plastic heels.

It is possible that in time a plastic may be evolved which shares with leather—and, to a lesser degree, with crêpe rubber—the quality of allowing the feet to "breathe." But until then leather is likely to remain the chief material.

Bordeaux, France. About sixty miles south-east from its entry in the Bay of Biscay, the estuary of the Gironde becomes the river Garonne, and here the traveller by sea reaches Bordeaux, one of the leading seaports of France and chief city of the department of Gironde.

The historic city has always been a great trade centre, famous for its wines, which are highly esteemed by good judges everywhere. The harbour, which can handle all but the largest vessels, is divided by the Pont de Bordeaux, a bridge of 17 arches. The city boasts many fine old buildings, notably the cathedral of St. André, the earliest part of which dates from the 11th century. It has a detached bell-tower. Other fine old buildings are the churches of St. Sevrin, St. Croix, and St. Michel, the last-named also with a detached



bell-tower, which has a spire 354 feet high. The Palais Gallien contains slight remains of a Roman amphitheatre, and several of the gateways of the city still stand. The town hall dates from the 15th century, but the law courts and the many commercial buildings are modern. Bordeaux is famous for its university, and has a library, a broadcasting station, and an observatory. The city is surrounded by a semicircle of boulevards ; beyond lie the suburbs on the vine-clad hills.

Bordeaux carries on a valuable trade in fish, timber, coal, and petrol, manufactures flour and beer, and processes tobacco. Shipbuilding and engineering are important industries. A large fleet of fishing boats is sent each year to the banks of Newfoundland and to Iceland.

Under the Roman Empire, Bordeaux flourished as Burdigala. From 1154 to 1453, as capital of Guienne, it belonged with all the surrounding country, to the English kings. In the 14th century the Black Prince held his court here, and here his son, later King Richard II, was born. During the French Revolution, Bordeaux was the headquarters of the moderate Girondists, and as such suffered greatly during the Reign of Terror. In 1814 it was the first French town to declare for the Bourbons (see article).

In 1870–71, during the Franco-Prussian War, and in the autumn of 1914, the French government moved to Bordeaux. It went there again in the Second World War, when it moved from Tours in June 1940, remaining there a fortnight before going to Vichy. The Germans secured the city under the armistice concluded with France on June 22, and turned it into a submarine base. They withdrew from it to the mouth of the Gironde after the Allies landed in the south of France in August 1944, so that Bordeaux suffered no military damage. The population in 1954 was 257,946.

Bordeaux wine is so called because it is exported from the city, and stored in great cellars there. It is made in the vine-growing districts bordering the lower Garonne and the Dordogne. A general name for the wines of this district is claret ; red clarets include Médoc and Saint-Émilion ; white clarets, Sauternes and Graves. Bordeaux wines are lighter than Burgundys.

Bore. In the sense of the very high, crest-fronted wave that rushes up some river mouths, the word bore is believed to come from the Old Norse *bára*, meaning wave. Another name for the phenomenon is eagre. It occurs when the high, or spring, tide enters an estuary wide at the coast and rapidly narrowing, so that the waters are pressed together and piled up into a foaming wall several feet above the normal water level. This wall sweeps on with a great noise, and to the danger of any shipping in its path. Notable bores occur on the Severn and the Trent in England, and in the Bay of Fundy in Canada, on the Seine in France, the Amazon in Brazil, the Yangtse in China, the Indus in Pakistan, and the Hooghly, India.

BORE ADVANCING UP THE RIVER SEVERN

A bore occurs when the high or spring tide enters a funnel-shaped estuary, and the waters are confined on a steadily-narrowing front, with the result that a wave is produced, which rushes upstream like a wall of foaming water several feet in height. This dangerous phenomenon occurs on the Severn and the Trent in England.

CESARE BORGIA
Soldier and statesman, Cesare Borgia, Duke of Valentinois, was unscrupulous and pitiless, like so many of the rulers of his day. Best known of this famous family, he was also a generous patron of artists, and Giorgione (1477-1511) painted this portrait of him which is in the Carrara Gallery at Bergamo in Italy.

Borgia, ITALIAN FAMILY (pron. bor′ja). Machiavelli, in his work *The Prince*, describes as his ideal a ruler who should be utterly ruthless and yet efficient to the last degree, while at the same time acting as a patron of the arts. Machiavelli is supposed to have taken for his model Cesare Borgia, most famous member of the Borgia family, powerful in Italy at the time of the Renaissance (revival of learning).

Of Spanish origin, the family of Borja (as it was spelt in Spain) came from Jative in the province of Valencia. They came to Italy in 1443, when Alfonso de Borja (1378–1458), Bishop of Valencia, accompanied Alfonso of Aragon in his conquest of Naples. Alfonso de Borja was elected Pope Calixtus III in 1455. He honoured many of his relatives, and his nephew Rodrigo (1431–1503) was elected Pope Alexander VI after wholesale bribery in 1492.

Alexander VI frankly used his office to build up the powers and fortunes of his children. Trickery, war, poison, and the dagger were freely used to gain his ends. These were the advancement of the Borgia family, the destruction of his enemies, and the unification of Italy under papal rule. To bring about this last end, he made an alliance with Charles VIII of France against Naples, the chief secular power in Italy, and in all other parts of Italy he aimed at reducing the power of the noble families. In this he was helped by his sons, the most important of whom was Cesare (pron. chāzah′rā) Borgia (1476–1507), who was made archbishop and cardinal before he was twenty. His brother Giovanni (1474–97), Duke of Gandia, was murdered, probably under the secret orders of Cesare, who, as the favourite son, was thus left alone to work with his father and share the rewards. Cesare was dispensed from his orders in 1498, and in 1499 married Charlotte d'Albret, princess of Navarre. Until 1503 he was in north Italy in an attempt to conquer the small independent states there. He had conquered Romagna, and was almost master of Tuscany, when his father suddenly died (August 18, 1503). Cesare, struck down with illness at the same time, was unable to influence the election of the new pope. The successor of Alexander VI, Pius III, reigned only a few months, and the next pope, Julius II, came from a family violently hostile to the Borgia family. Cesare fled to Naples, was arrested there, and was taken to Spain. He escaped from prison in 1506, and took service under his brother-in-law, the King of Navarre, for whom he died fighting at Viano, March 12, 1507. Cesare was by far the cleverest member of an unscrupulous family. However, modern research has led historians to doubt whether scientific knowledge had advanced enough in the days of the Borgias to make possible the poisonings with which they have been credited.

Other children of Alexander VI were Jofre (b. *c.* 1482), whose descendants held the Borgias' Spanish lands until 1748, and Lucrezia (1480–1519; pron. lookrāt′sia). She was very beautiful, and was once thought to have been a monster of wickedness. But she is now believed to have been merely a tool in the hands of her unscrupulous family, who arranged her marriages for political ends. She married first, Giovanni Sforza of Pesaro in 1493. When her father was for a time at enmity with the Sforzas, the marriage was dissolved (March 1497). Then she married Alfonso, Duke of Bisceglie, to whom she was devoted. But Cesare feared their influence over Alexander VI, and had Bisceglie murdered (1500). Finally in 1501 Lucrezia married Alfonso d'Este, who succeeded to the Duchy of Ferrara in 1505. As Duchess of Ferrara she showed herself a woman of grace and gentle manners, a patron of art and learning, and a supporter of charitable works.

Francis Borgia (1510–72), a later member of the Spanish branch of the family, became famous in quite a different sort of way as a pious and able general of the Jesuits. He was canonised in 1671.

Borneo. Within living memory a visitor staying with the Dyaks, one of the primitive peoples who live along the jungle rivers of the island of Borneo, in the Malay Archipelago, might have had to sleep in a barn-like structure built above the ground on high stilts, with a cluster of blackened human skulls hanging from the rafters. For the Dyaks thought they were honouring a visitor by lodging him in this "head-house," where they kept the heads of their slain enemies. To-day head-hunting is virtually a thing of the past. Present-day Dyaks are in many ways a pro-

Dr. Chas. Hose

PRIMITIVE SCENES OF NATIVE LIFE IN BORNEO

The people of Borneo cling to their old ways. Blowpipes, for instance, are still generally used by the hunters. Two Kayan men (left) are making a blowpipe out of a length of hard wood called "jangwang." One man stands on a platform and hammers downwards with an iron rod, while the other pours water into the hole to float out the chips. A young hunter (top right) is returning home with a pig he has killed with his blowpipe. The gallery of a Kayan house (lower right) serves as a gathering place for those who live in the rooms that open out of it. Against the inner wall (left) is one of the huge mortars used for husking rice.

gressive community where all villages are communal and all wealth is shared.

The Dyaks, the former "wild men of Borneo," are for the most part peaceable farmers, but are still pagans, though some villages are now Christian. Over their tattooed bodies the men wear khaki shorts or just a loincloth. Women wear a skirt (sarong), but often no clothing at all above the waist. As Borneo lies north of the equator the climate is oppressively hot and humid, with day temperatures of 90° F. in the shade. There are no hot or cold seasons and it rains almost every day.

The people of Borneo are divided into many tribes and races, some classed as Dyaks, some as Lauts, Ibans, or Sea Dyaks, who inhabit the coast. The Chinese account for about one-quarter of the population, living mostly in towns and villages along the coast. Of the other races, the most advanced are the Malays, whose ancestors came from Malaya or Indonesia centuries ago. They are Mahomedans, speaking the same language as the Malays of Malaya, and are civilized people who have long been organized under their sultans or under British rule.

The most primitive tribes subsist on jungle food, or by hunting, and live in the dense forests. The others live along the coast or the banks of rivers

easily accessible to canoes. Rice forms the staple diet of the majority of the population; more than half of all the cultivated land is planted with rice.

Borneo is the fourth largest inhabited island in the world, and is situated between the Asian mainland to the north and Australia to the south. Its total area is about 290,000 square miles; the population a little over 4 million. Three-quarters of the island forms part of the Republic of Indonesia and has been renamed Kalimantan. The northern part (approximately 81,725 square miles), with a population of nearly a million, is part of the British Commonwealth.

If you should gaze down upon this vast island from an aeroplane you would see it all as one great emerald patch of jungle, with ridges of forest-clad mountains traversing it irregularly. Threaded through the forests you would see many rivers bearing small cargo steamers and fishing canoes. Thanks to abundant rainfal and the tropical climate, trees and plants grow very quickly. The Borneo jungle is luxuriant, dark, green, and damp. Here grow in profusion iron-wood, teak, ebony, and other valuable timbers which form one of the country's chief natural resources. With these are intermingled camphor trees, fan palms, coconut and rubber trees, and towering ferns. A large proportion of the coconut and rubber crops are exported to Britain, as are tapioca and sago.

Through these tangled jungles wander the wild ox, the tusked pig, and the honey bear. The rhinoceros and the elephant feel their clumsy way over fallen tree-trunks; and the orang-utan—that powerful, human-looking ape, called by the Dyaks the jungle-man—swings by its hairy arms from branch to branch. Through the tree-tops at night darts the flying-fox. Crocodiles haunt the rivers, and lizards, frogs, snakes, and tortoises abound. The rivers and surrounding seas furnish the Sea Dyaks with an abundance of edible fish.

For more than a century about a sixth of the island was under the absolute rule of a white man.

WRESTLERS OF BORNEO

Like other primitive people, many of the native tribesmen of Borneo delight in feats of strength, and, in particular, in wrestling. Here we see two young Kayan men "in position"; each grips his opponent's waist-cloth, and strives to overturn him with one mighty throw.

This district, an area of about 50,000 square miles, is Sarawak. Sir James Brooke (1803–1868), an Englishman, in 1840 assisted the sultan of Brunei in putting down a revolt, and in return the sultan made him in 1841 governor and rajah of Sarawak. The title was hereditary, and on the death of Rajah James Brooke it passed to his nephew Sir Charles Brooke (1829–1917). His son, Sir Charles Vyner Brooke (b. 1874), abdicated in 1946, ceding Sarawak to Great Britain as a crown colony.

British Borneo is made up of three territories: (a) the Protectorate of Brunei (2,225 square miles); which is ruled by a sultan assisted by a British Resident; (b) the Crown Colony of British North Borneo (29,500 square miles), which was ruled by the British North Borneo Company from 1881 to 1946 (except for the years 1942–1945 when it was occupied by the Japanese); (c) the Crown Colony of Sarawak.

North Borneo and Sarawak are each ruled by a governor, assisted by an executive council consisting of British, Chinese, and local Borneans. But whereas the people of North Borneo and Sarawak are considered British citizens, the people of Brunei are subjects of the sultan; though under British protection, they are not British nationals.

Borneo has rich deposits of coal, iron, gold, diamonds, silver, platinum, tin, and petroleum. It produces in profusion spices, nuts, and numerous tropical fruits. Sugar cane, coffee, cotton, rice, and tobacco are cultivated along the coast and rivers. Agriculture is the main occupation, while boat-building, weaving, iron-working and the production of mats and baskets are leading industries. The oil wells at Seria (in Brunei) and at Mir (in Sarawak) are now producing a total of more than five million tons a year.

During the Second World War, Borneo was occupied by the Japanese. They landed in Sarawak on December 16, 1941, nine days after they entered the war, and by the middle of the following February all organized resistance to them had ceased. In May 1945, Australian troops began the reconquest of the island; fighting was still going on when Japan capitulated on August 14, 1945, but had ceased by September 10.

Borrow, George Henry (1803–81). A Gypsy jingle which prefaces Borrow's last book—an account of the language, songs, etc., of the English Gypsies—reminds us that he set great store by his friendship with the Gypsy, or Romany, people. It runs:

> Can you rokra Romany?
> Can you play the bosh?
> Can you jal adrey the staripen?
> Can you chin the cost?

George Borrow is an outstanding "character" among English writers. Six feet three inches tall, expert at boxing, swimming, and managing a horse, ready to converse in almost any language, a prodigious walker, preferring the life of a tramp to that of the respectable professional man he might have been, wherever he went he instinctively attracted adventures and strange people.

He was born near East Dereham, in Norfolk, but as his father was an army recruiting officer the family never stayed long in one place until he retired, when George was thirteen. They settled in Norwich (their house is now the Borrow

Museum), and after attending the high school George was articled to a solicitor. He cared little for either school or profession, but set himself instead to develop his great gift for languages, studying the Bible in Armenian, translating Welsh and Danish ballads, learning the Romany tongue from his Gypsy friend, Jasper Petulengro. After his father's death in 1824 he came to London, but failed to make a living by literary work, and for several years lived as a tramp, spending much of his time with the Gypsies and visiting various European countries. In 1832 he was recommended to the British and Foreign Bible Society for his ability to "read the Bible in 13 languages." The society sent him first to St. Petersburg (Leningrad), where he succeeded in printing the New Testament in a Chinese language. He then travelled through Spain, Portugal, and Morocco, distributing Bibles. In Madrid he was imprisoned.

GEORGE BORROW

This delicate-featured young man hardly looks as if he would be the sort to "rough it," yet George Borrow spent so long with the Gypsies that he came to prefer their life and language to his own. This portrait is by Henry Wyndham Phillips, and hangs in the National Portrait Gallery, London.

In 1840 he returned to England, married, and settled down at Oulton in Suffolk. There he wrote *The Bible in Spain* (1842), and this account of his journeyings proved such a success that he was urged to write more of his adventures. *Lavengro* (1851) and *The Romany Rye* (1857)—the titles, in Gypsy language, mean The Word-Man, or Linguist, and The Gypsy Gentleman — were less successful, however. Respectable people, shocked by his obvious pleasure in the company of rogues and vagabonds, failed to recognize his originality. His last autobiographical book, *Wild Wales* (1862), by some people considered his best, was the outcome of a journey in that country, made in 1854. Most of his later life was spent in London; but he died at Oulton.

Borrow's wandering life made him few real friends, and he was in some ways a sad and lonely man. But his books are unique for their mixture of vigorous out-of-doors enjoyment, odd encounters of every sort, and that knowledge of what goes on in the byways which so fascinates people whose orderly lives are spent in houses and cities.

A GYPSY ON THE JOY OF LIVING

In a famous passage from "Lavengro," his autobiography, Borrow talks to the Gypsy, Jasper Petulengro, about life and death.

"When a man dies [says Petulengro] . . . if he is quite alone in the world, why, then, he is cast into the earth, and there is an end of the matter."

"And do you think that is the end of a man?"

"There's an end of him, brother, more's the pity."

"Why do you say so?"

"Life is sweet, brother."

"Do you think so?"

"Think so! There's night and day, brother, both sweet things; sun, moon and stars, brother, all sweet things; there's likewise the wind on the heath. Life is very sweet, brother; who would wish to die?"

"I would wish to die——"

"You talk like a gorgio—which is the same as talking like a fool—were you a Rommany Chal you would talk wiser. Wish to die, indeed! A Rommany Chal would wish to live for ever!"

"In sickness, Jasper?"

"There's the sun and stars, brother."

"In blindness, Jasper?"

"There's the wind on the heath, brother; if I could only feel that, I would gladly live for ever. Dosta, we'll now go to the tents and put on the gloves; and I'll try to make you feel what a sweet thing it is to be alive, brother."

Bosnia AND HERZEGOVINA. Anyone who knows his history will remember that the immediate cause of the First World War (1914–18) was the assassination of the Austrian Archduke Franz Ferdinand and his wife at Sarajevo on June 28, 1914. Sarajevo is the capital of Bosnia, which, with the neighbouring Herzegovina, forms a federal unit of Yugoslavia. Coveted by many nations, Bosnia and Herzegovina have had a stormy history. Once part of the vast Roman Empire, after the barbarian invasions they eventually became a Slav kingdom.

In the 15th century, with the rest of the Balkans, they were conquered by the Turks, under whose rule they remained until 1877. In that year, with the aid of Russia in the Russo-Turkish War, they gained the right of self-government from Turkey, but then the Great Powers of Europe interfered, and by the Treaty of Berlin (1878) Bosnia and Herzegovina were handed over to Austria to govern, though nominally still under Turkish domination. Austria annexed them both in 1908, and kept them until, in 1918, they became part of the new kingdom of the Serbs, Croats, and Slovenes (later Yugoslavia). The main occupations of the people are agriculture, mining, and forestry, and the chief exports are wheat, hay, potatoes, prunes, raisins, hides, skins, wool, minerals, and timber. Nearly half the inhabitants belong to the Greek Orthodox Church, with large minorities of Roman Catholics and Muslims. The area is 19,909 square miles, and the population at the census of 1953 was 2,843,486.

Bosporus. One of the most famous waterways in the world is the beautiful river-like strait of the Bosporus (or Bosphorus), at the southern entrance of which stands Istanbul, the

former capital of Turkey. It lies between the Black Sea and the Sea of Marmara, and forms part of the dividing line between Europe and Asia Minor.

For 16 miles the strait, from one-third of a mile to two miles wide, winds in and out through a picturesque landscape dotted with cypresses, laurels, and ancient plane trees, while the shores themselves are lined with towns and villages, ancient towers and modern forts, and palaces and summer homes of the wealthy. The Golden Horn, an inlet on the European side, forms the harbour of Istanbul. Treacherous currents and fogs around the northern end of the Bosporus make navigation dangerous, and a number of lighthouses have been erected. In Classical times the strait was called the Thracian Bosporus.

By a treaty of 1841 no warships other than those of Turkey were allowed to pass through the Bosporus without permission of the Turkish government. This was confirmed by the Treaty of Berlin in 1878. Under the Treaty of Lausanne, 1923, the Bosporus was demilitarised and opened to all ships. But by the Montreux convention, 1936, Turkey was allowed to refortify both the Bosporus and the Dardanelles.

The word "Bosporus" comes from Greek and means "ox-ford," suggested by the legend that the goddess Io swam across the strait after having been given the form of a heifer by Zeus.

BOSTON STUMP BESIDE THE WITHAM

Boston, in Lincolnshire, is a pleasant little port and market town. Boston Stump, the 290-feet-high tower of the church of St. Botolph's, is a landmark visible for many miles in the flat surrounding country. Jean Ingelow (1820–97), who was born in Boston, immortalised its bells in her poem "The High Tide on the Coast of Lincolnshire," by which she is best remembered.

Boston, England. In the 17th century men sailed from the port of Boston in Lincolnshire to found another Boston in America (see next article). The older Boston, which is a charmingly placid little town in these days, had from the 13th century been one of the leading ports in England and had been made a borough by King Henry VIII. But it declined even as the Boston in

THE BOSPORUS AND ITS CASTLE-CROWNED SHORES

For about 16 miles the Bosporus, which connects the Black Sea with the Sea of Marmara, winds between shores dotted with groves of cypresses and laurels, and past villages and ancient strongholds. On the European side and about half-way through the strait is the fortress of Rumeli Nissar (above), and on the Asiatic shore is the sister castle of Anatoli Nissar, both built in the 15th century against the Turkish threat to Constantinople (Istanbul).

America grew great. But visitors to the parish church, one of the largest and finest in Britain, will see that much of its interior beauty to-day is due to the generosity of Americans, who have a special affection for this home of their ancestors. The tower of the church is the famous Boston Stump (see illustration, previous page). It is dedicated to St. Botolph, and Boston is a contraction of St. Botolph's town, that saint having founded a monastery there in 654.

Boston is on the river Witham, about five miles from the Wash and 28 miles south-east of Lincoln. The Witham silted up in the 18th century, but it was artificially deepened and a dock constructed in 1880–90, so that the port could be used again.

Boston is a market town for the surrounding rich agricultural country, on which depends also its chief industry of fruit and vegetable canning. The population in 1951 was 24,453.

Boston, U.S.A. The capital of Massachusetts is among the most historic and individual of all American cities. It was founded in 1630 by Puritan settlers from England, whose first name for it was Trimontaine, from its three hills. This was changed to Boston in honour of the Lincolnshire town whence many of the settlers had emigrated, and the two Bostons, thousands of miles apart, still keep up a friendly relationship.

The American Boston was long the chief centre of Puritanism and of learning. It is still a great educational and artistic centre, proud of its tradition of culture. Not only are there a university and several colleges there, including the famous Massachusetts Institute of Technology, but in the suburb of Cambridge, across the Charles River, is the great University of Harvard. It is also a busy port. The harbour has 40 miles of berthing space, with one of the world's largest dry docks.

The same Puritan spirit which led to the stern punishment of heretics, Quakers, and witches in the 17th century also helped to make Boston the rallying place of opposition to the oppressive measures of England in the period preceding the War of American Independence. The Boston massacre of 1770, the "Boston Tea Party" (*see* AMERICAN INDEPENDENCE), the Battle of Bunker Hill in 1775 (which could be watched from Boston's waterfront), and the British evacuation of Boston are famous events. It was from Boston that Paul Revere rode at midnight to the villages of Massachusetts to warn the citizens that the English troops were on the march against them (romanticised in a poem by Longfellow). Yet Boston somehow continues to look more like an English provincial city than any other place in the western hemisphere. Its layout and architecture are English rather than American, and Boston people themselves remain more like the English in their ideas and habits than other Americans are. Beacon Street and Louisburg Square in the fashionable residential quarter might well be in Chelsea; but Boston Common, a large open space near the centre of the city, reminds the English visitor of Southampton or of Woodhouse Moor, Leeds, rather than of Hyde Park.

The city's many products include clothing, shoes, sugar, rubber wares, and confectionery, and it is a famous publishing centre and the chief wool market of the U.S.A. The population of Boston proper was 790,863 in 1950.

Boswell, JAMES (1740–95). "I do indeed come from Scotland," said Boswell, on being introduced to Dr. Johnson, "but I cannot help it." "That, sir, I find is what a very great many of your countrymen cannot help!" growled Johnson. Poor Boswell, only 22 and most anxious to shine in literary society, was "not a little embarrassed and apprehensive" at this snub, but before the evening was over the great doctor, thirty years his senior, had been kind enough to encourage more acquaintance, and after their third meeting Boswell wrote in his Journal: "I am never with this great man without feeling myself better and rendered happier."

So began that most profitable friendship. For Boswell it meant acceptance by Dr. Johnson's distinguished friends—Reynolds, Garrick, Goldsmith, and other notables. But Johnson could hardly guess that it was to secure his own place in the hearts of future generations of his countrymen. Johnson was a notable writer but a

BOSTON, MOST ENGLISH-LOOKING U.S. CITY

The general plan and architecture of Boston are English rather than North American. The picture shows Beacon Street, which borders Boston Common, and public gardens. Named after Boston, Lincolnshire, the city is the cultural, educational, industrial, and fishing centre of New England and the principal wool market of the United States.

greater man. His works are now read chiefly by scholars, but his brilliant talk, his affectionate letters, his oddities, the fearsome outbursts that seldom hid for long his infinite kindness of heart, live on in the most famous and the most readable of all biographies, the one which Boswell wrote after Johnson's death. That this should be so was the faithful and devoted Boswell's dearest wish. "Grave Sam and great Sam," he said, "solemn Sam and learned Sam—all these he has appeared over and over. Now I want to entwine a wreath of graces across his brow; I want to show him as gay Sam, agreeable Sam, pleasant Sam."

BOSWELL'S FIRST MEETING WITH DR. JOHNSON

James Boswell, famous for his biography of Dr. Johnson, first met the Doctor in London in 1763, and in this painting by Eyre Crowe (1824-1910) the "Great Cham of literature" is seen greeting the ambitious but bashful young Scot. Shortly afterwards Boswell went to the Continent, returning to England in 1766 to become the Doctor's constant companion and disciple for many years. Boswell died in London on May 19, 1795.

Boswell belonged to an ancient family and was the son of a Scots lawyer, Alexander Boswell, who took the life title of Lord Auchinleck (pron aff'lek) on becoming a judge in Scotland. Boswell inherited from his father an estate in Ayrshire. He was educated in Scotland, but his father allowed him to visit London in 1762. It was then he began seriously to keep his Journal. He wrote down everything—not only his conversations with Dr. Johnson, but accounts of all the people he met, and all his adventures and mishaps. Occasionally he made notes on the spot. More often he jotted them down as soon as he could and wrote them up in full every few days.

It was well known that he made use of his Journals both for the *Life of Johnson*, published in 1791, and for his *Journal of a Tour to the Hebrides with Samuel Johnson, LL.D.* (1785). But the Journals themselves and all his letters and papers disappeared after his own death, and were believed to have been destroyed. The account of their re-discovery is as exciting as a detective story. First a great bundle of letters was recovered in 1857 from a waste-paper merchant in Boulogne. Then, during the present century, at Malahide Castle in Ireland, and Fettercairn House, Scotland, in lofts and lumber-rooms, sacks and boxes, piles of journals, letters, and manuscripts were found. Their recovery is due chiefly to an American collector, Ralph H. Isham. Now they are being edited, and providing fresh evidence of Boswell's genius, for he *was* a genius, though for a long time regarded as something of a buffoon.

The *London Journal, 1762–63*, published in 1950, contains Boswell's original account of his earliest meetings with Dr. Johnson. The Journals contain, too, some episodes that his family understandably wished to keep dark. But readers owe him so much for the honesty of his records that they are little disposed to blame his faults. His friendliness, indeed, outbalanced many weaknesses, and did not Johnson himself say that he was a man whom everybody liked, and that "Boswell never left a house without leaving a wish for his return"?

Bosworth Field, BATTLE OF (1485). The final battle in the Wars of the Roses (*see* ROSES, WARS OF THE), and one of the decisive battles of English history, was Bosworth Field. The reign of Richard III, little over two years long, had been disturbed by baronial conspiracies, and when Henry Tudor, Earl of Richmond, a Lancastrian descendant of Edward III, invaded England to claim the throne, many knights and gentlemen joined his army. On August 22, 1485, he encountered King Richard near Market Bosworth, some 12 miles west of Leicester. Although the royal forces were about 15,000 strong, compared with Henry's 5,000, Richard could not rely on the loyalty of several of his chief supporters. Henry attacked, and the result of the battle was decided when Lord Stanley and Sir William Stanley brought their followers into the battle on Henry's side. The Earl of Northumberland held his force inactive throughout the action. Richard was advised to flee, but charged with a few followers into the midst of the opposing army, cut down Henry's standard-bearer, and was killed in desperate hand-to-hand combat. His army made little further resistance, and the Earl of Richmond was crowned on the field of battle as Henry VII. Thus the first Tudor king of England came to the throne.

The SCIENCE *of* PLANTS *and* FLOWERS

Botany. As early man slowly became civilized, he probably became something of a botanist, for he had to study plants in order to get some of his food, fodder for his animals, medicine, and (later) fibres for cloth-making. The word "botany," meaning the study of plants, comes from the Greek word for "plant." The Greek philosopher Theophrastus, successor to Aristotle, has been called "the father of botany." It was he who first attempted an organized study of plants. The first serious botanists in Europe were the herbalists, whose work on medicinal plants began in the 16th century and spread over the 17th. After this came the naturalists, who were interested not only in plants, but also in animals, rocks, soils, climates—in nature generally, although some studied plants in greatest detail. They tried to bring order into the masses of information they gathered, first by grouping plants into families. Morrison and Ray began in England; some great French botanists followed; and then came the work of the famous Carl Linné or Linnaeus (see article) in Sweden, published in 1775. To every plant and animal he studied he gave two Latin names, a group name for its "genus" and an individual name for its "species." For instance, every kind of buttercup was called *Ranunculus*, but the meadow kind was *Ranunculus acris*, the creeping kind *Ranunculus repens*, and so on. Most of these names are still used.

Other botanists have continued this taxonomy (classification), and now genera (plural of genus) are grouped into families, and families into phyla (plural of phylum). The plant world consists of five phyla: algae (seaweeds and microscopic water plants) and fungi (mildews, toadstools, etc.), make the first phylum, called Thallophyta; liverworts and mosses are Bryophyta; ferns and horsetails are Pteridophyta (many of which are now extinct and found as fossils); conifers and their relations are Gymnosperms, because they have naked seeds; finally deciduous trees, shrubs, and all flowering plants are Angiosperms, with seeds enclosed in cases. This group is the most fascinating for study by non-experts. You need a book called a Flora, a pocket lens, curiosity, and a love of outdoor life, and the beauty and wonder of even the commonest wild flowers will keep you contented even if you fail to find any rare ones. A collection of pressed flowers is called a herbarium, but a collection of coloured drawings is a more precious possession for an artistic botanist. He gets to know his plants intimately, whereas pressed flowers will fade and crumble, and some are too large to press.

FLOWER FERTILISATION

When an insect enters the sweet-pea flower (upper), its weight presses down certain petals, and the parts carrying the pollen convey some of it to the body of the insect. In the foxglove (lower) a bee climbing up to the nectar becomes dusted with pollen. Flower details are further explained on the back of the colour plate.

The study of plant form is called morphology. To the botanist almost every visible part of a plant or tree is either root, stem, or leaf. One is surprised at first to find that a flower is a collection of special leaves of four kinds—sepals, petals, stamens (making pollen), and carpels (forming pistils and making seeds). Seeds themselves contain simple leaves called cotyledons. Other surprises are that the fruit of the apple or pear is the core and what we eat is the enlarged juicy stem around it; that the potato is not a root but the swollen end of an underground stem; that a vegetable marrow is a fruit of the berry type; and that botanically speaking, walnuts, almonds, coconuts, and Brazil nuts are none of them really nuts.

Since the invention of the microscope a great deal has been discovered about how plants are constructed, that is, their internal anatomy. Robert Hooke was one of the first to publish (in 1665) a book illustrating plant anatomy. Slices thinner than tissue paper are cut from stems, leaves, roots, etc., by a "cut-throat" razor, or by a machine called a microtome, working like a bacon-slicing machine. These are carefully stained with special dyes and mounted in an air-tight substance between thin layers of glass. The tough core of the root, the fibrous strands of the stem, and the veins of the leaf are seen under the microscope to consist of beautifully arranged cells, like little tubes of strong but pliant material, among the delicate, almost bubble-like cells around them. Engineers know that a

SOME BRITISH WILD FLOWERS

The popular name is here followed (in brackets) by both the popular and the botanical names of the plant's family. (1) Sainfoin (Pea, *Leguminosae*). (2) Meadow Crane's Bill (Crane's Bill, *Geraniaceae*). (3) Sweet Violet (Violet, *Violaceae*). (4) Marsh Marigold (Buttercup, *Ranunculaceae*). (5) Ox-eye Daisy (Daisy, *Compositae*). (6) Soapwort (Pink, *Caryophyllaceae*). (7) Red Poppy (Poppy, *Papaveraceae*). (8) Dog Rose (Rose, *Rosaceae*). (9) Autumn Gentian (Gentian, *Gentianaceae*). (10) Honeysuckle (Honeysuckle, *Caprifoliaceae*). (11) Round-leaved Sundew (Sundew, *Droseraceae*). (12) Harebell (Bellflower, *Campanulaceae*). (13) Arrowhead (Arrowhead, *Alismaceae*). (14) Rock-rose (Rock-rose, *Cistaceae*). (15) Lady's Smock (Crosswort, *Cruciferae*).

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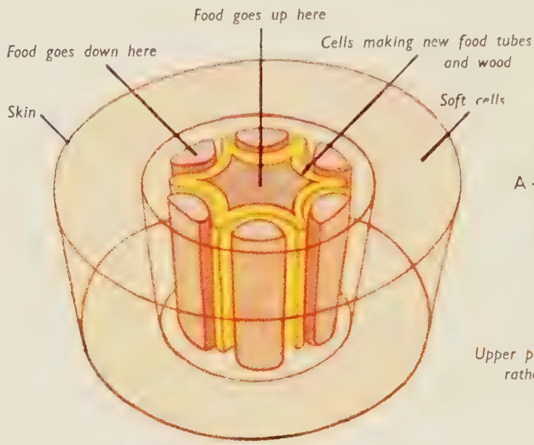
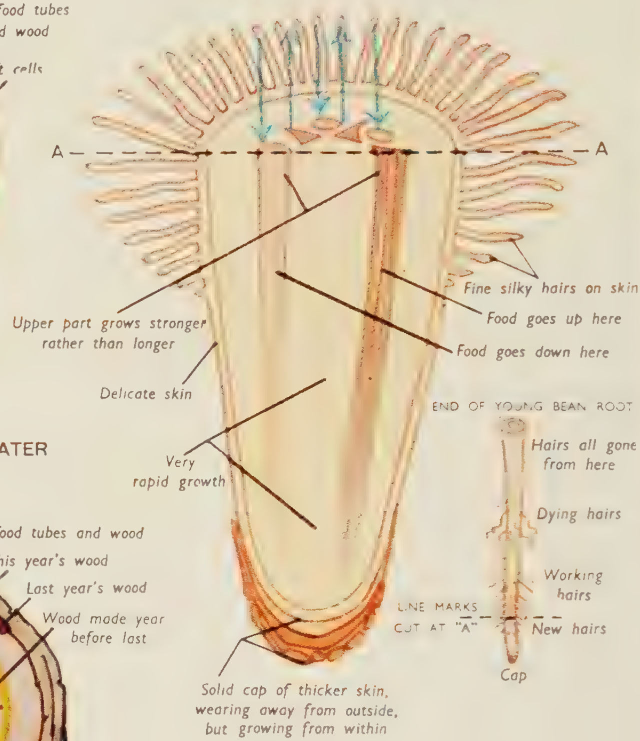
ROOT GROWTH AND STEM FEEDING SYSTEM

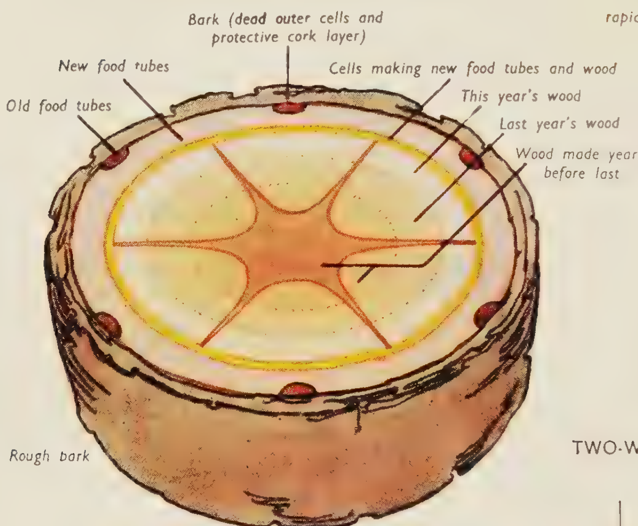
SLICE FROM A VERY YOUNG LIME TREE ROOT



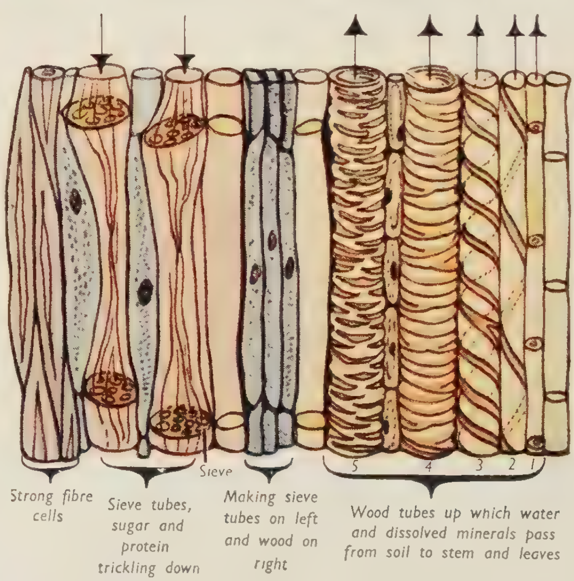
SECTION OF A BEAN ROOT TIP



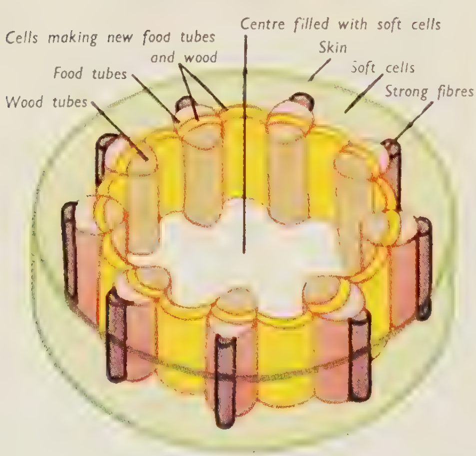
THE SAME LIME ROOT THREE YEARS LATER



TWO-WAY TRAFFIC SYSTEM FOR FEEDING AND SUPPORT IN A SUNFLOWER STEM



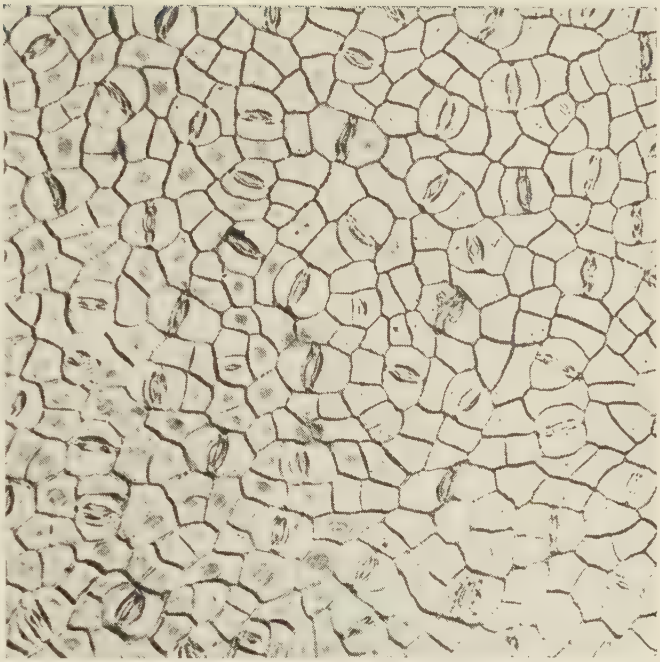
INSIDE A YOUNG STEM



Specially drawn for this work by Nora L. Southworth

standing column is stronger hollow than solid, and that cables which have to resist a pull lengthways need their strength in the centre. These arrangements existed in plant stems and roots long before engineers—or even men—existed. Every part of a plant has a construction exactly right for its function.

The study of living cells is called cytology. For this, not only the ordinary microscope but also the ultra-microscope and electron-microscope are used. Some cells are no larger than a thousandth of a millimetre across, although most are from ten to fifty times as large; but the central living nucleus needs high magnification to show its details. Plants grow by dividing cells into two, enlarging them, and dividing again repeatedly. The nucleus divides first, and when it is about to do so, tiny worm-shaped things called chromosomes can be seen in it by staining. They are there all the time but can soak up stains and become visible only when division time comes. Every cell of the plant has the same even number of chromosomes in its nucleus except pollen grains and the cells which will become the living part of the seeds by uniting with pollen; these have exactly half the number. The full number is 14 in wallflower and sweet pea, 28 in elm, 40 in holly, each kind of plant having its own definite number. By these tiny chromosomes, plants inherit from their parents their colour, height, shape, and other characteristics.



E. A. Botting

HOW A PLANT BREATHES

Magnified 250 times, this strip of the surface tissue of a leaf displays the stomata, or breathing pores, by which the plant breathes. These are visible in the photograph as lens-shaped bodies among the other cells. The stomata breathe in carbon dioxide and pass out moisture.

The study of breathing, feeding, and growing in plants is called physiology. Much can be learned by simple experiments about the effects of light and darkness, heat and cold, on plants, but to study physiology in detail the botanist must first know something of chemistry and physics. The plant is a food-making factory, using a process called photosynthesis (see article) and sucking up dissolved salts from the soil. It has its own transport system of veins to carry the food to the rapidly growing parts or to special store-houses such as bulbs and seeds. Its leaves are like lungs—air goes in and out through their pores—but part of the air is used for food-making, while the oxygen turns the food into energy for growing.

Where Plants Live

The kind of place in which a plant will grow wild is called its habitat. The habitat of a primrose is a wood, that of heather is moorland or heath, and so on. In each habitat certain kinds of plants tend to grow together in a " plant association," and the study of such groupings is called ecology (see article). One interesting thing about associations is that they seem to be slowly changing from year to year. The make-up of the association has a great influence on changing the soil; this may be helpful to some plants and harmful to others.

Ecology may lead to plant geography, showing where the various kinds of plant are found in the world and how they spread. Some very interesting ideas about land bridges across seas in long-past ages have been suggested by this branch of botany.

As the population of the world increases, it is more and more important for people to study agricultural botany. Not all mankind are vegetarians, but everyone depends on plants for food, because plants form the food of all the animals and birds that are eaten by non-vegetarians, and even fish-eating fishes live on those which feed on sea plants. So people have learned something of plant pathology, that is, the diseases that attack crops; they have put plant physiology to good use in providing light, shade, warmth, water, and fertilisers for crops, and their knowledge of cytology has led to the branch called genetics (see article), which is plant breeding. By patiently transferring pollen from one variety of wheat to another, for instance, they have developed wheats of many types, resistant to diseases and suited to different soils and climates. The horticulturist's vegetables and flowers and the forester's timber trees have also benefited from all these botanical studies. (See such related articles as ALGAE, FLOWERS, FRUIT, PLANT LIFE, TREES, and the articles on the individual flowers, plants, trees, and vegetables.)

Botticelli, SANDRO (1447?–1510) (pron. bottēchel′lē). In the great days of the Italian Renaissance (or revival of learning), Italy was divided into a number of little states centring round the big cities, and ruled over by rich and princely families. In Florence, during those days, there was born a boy called Alessandro di Mariano dei Filipepi. His father was a tanner, and Alessandro was first apprenticed to a goldsmith.

SPRING, AS DEPICTED BY THE ITALIAN ARTIST BOTTICELLI

Primavera (Spring) is one of Botticelli's best-known works, and is among the most beautiful allegorical productions of the Renaissance. Among his special qualities as a painter were extraordinary skill as a draughtsman for intricate linear design, and ability to convey the feeling of open air. He had a masterly power of drawing animals and of representing flowers and foliage. In his paintings there is an escape from the earlier stiffness of drawing.

But he soon tired of this work, and started to learn painting under a famous artist, Fra Filippo Lippi, studying later under the Pollaiuoli brothers. His masters found real genius in the youth. He made rapid progress, and, under the nickname of Botticelli (which he got from an uncle), he became much in demand by the noblemen and clerics who were then the chief buyers of pictures.

Probably some time in his twenties Botticelli achieved a real triumph by attracting the attention of Lorenzo de' Medici, ruling prince of Florence. For this patron he produced a " Mars and Venus " (National Gallery, London), a " Birth of Venus " (Uffizi Gallery, Florence), and, most famous of all, a " Primavera " (or " Spring "), hung in the Academy at Florence and here illustrated.

This last is one of the world's great paintings, and deserves close examination and deep thought. In what way do these tall, graceful maidens bring up the idea of spring ? It is the grace. the freshness, the sparkling joy in the picture that strike us most when we look at it carefully. The drawing is superb (if not strictly " correct " from the anatomical point of view). Movement, hope, and gracious beauty are to be found in it.

Between 1481 and 1483 Botticelli was in Rome, working for Pope Sixtus IV on frescoes (wall paintings on plaster) in the Sistine Chapel. He then returned to Florence worked at engraving. and illustrated Dante's *Divine Comedy*. He painted many tender, charming versions of the " Madonna and Child " in circular compositions called *tondi*.

Bougainville, Louis Antoine de (1729–1811). One of the Solomon Islands, lying in the Pacific Ocean to the north of New Guinea, is called Bougainville in honour of a very distinguished Frenchman, whose name is also commemorated in the South American shrub, bougainvillea. Bougainville first made his mark as a mathematician, when he published a learned treatise on the mathematical process called the integral calculus. Then he became a soldier, and served in Canada from 1756 to 1760 as aide-de-camp to General Montcalm in the fight against the British. He directed the French retreat from Quebec after the battle fought there in 1759 in which both Montcalm and the English General Wolfe lost their lives. From 1761 to 1763 he fought in Europe, in the Seven Years' War. Then he joined the French navy.

In 1764 he sailed to the South Atlantic to found a French colony in the Falkland Islands (though this was given up a few years later in order to appease the Spaniards). Then, during the years 1766–69, he sailed right round the world, the first French navigator to do so. The account of his voyage added greatly to the geographical and scientific knowledge of his day. In the course of that voyage he re-discovered the Solomon Islands, which had first been reached by a Spaniard in 1568 and then lost again. In his old age, Bougainville was made by Napoleon a Count of the Empire.

The island of Bougainville is about 3,880 square miles in area, and very mountainous (Mount Balbi, 10,170 feet). It became a German possession

in 1893, and after the First World War was placed under Australian mandate by the League of Nations. In 1942 Japanese forces seized the island, which was undefended. American marines secured a foothold there late in 1943, and were relieved a year later by Australian troops. Fighting of a particularly savage kind continued until after the end of the war with Japan in 1945, by which time the Australians had regained most of the island, which is now administered by Australia as a United Nations trusteeship territory.

Bougainvillea, a climbing shrub of the family *Nyctaginaceae*, is a favourite in British greenhouses because of the showy, rosy-coloured bracts that surround its small, green-tinted flowers. It is native to South America.

Bounty, H.M.S. The voyage on which 44 men under William Bligh (1754–1817) set sail in the transport *Bounty* in 1787 would have been romantic enough had it gone simply according to plan. She displaced 250 tons and was 90 feet long, and was a little ship even in those days; but she was to sail to the beautiful South Sea island of Tahiti, then lately discovered by Captain Cook, to collect cuttings of bread-fruit trees and take them to the West Indies, where it was hoped they would flourish and provide food for the slaves on the sugar plantations. The voyage of the *Bounty*, however, is remembered not for tree-planting but for the most famous mutiny in British history.

Tahiti was reached after many discomforts, and Bligh's evil and cruel temper made matters worse. The ship remained for several months, and the crew made the most of tropical luxury and the cheerful friendliness of the islanders. By some accounts luxury undermined discipline. At all events, shortly after the *Bounty* left with her bread-fruit trees, bad feeling between captain and crew came to a head, and on April 28, 1789, the master's mate, Fletcher Christian, forcibly took command of the ship. Bligh and 18 loyal members of his crew were put in a 23-foot open boat. They had no chart and few provisions, and it seemed unlikely that they could keep alive for long. But Bligh, whatever his faults, was a superb sailor, and in seven weeks succeeded in sailing 3,618 miles to the island of Timor, in the East Indies. Eventually he reached England, reported the mutiny, and survived to become a vice-admiral.

Meanwhile the mutineers returned to Tahiti, where some decided to settle. These men were later seized and brought back to England, where three of them were hanged. But Christian and seven others, with their Tahitian wives and several island men, took the *Bounty* to the remote island of Pitcairn. There, after 20 years, the sole surviving mutineer, John Adams (known also as Alexander Smith), was found in charge of a little colony of women and young people bearing the names of Christian and the other mutineers. All but one of the other men had been killed in quarrels, but Adams, a good, devout man, had taught the children from his Bible and prayer-book, and brought them up well. Some of their descendants live on Pitcairn still.

The full story of the adventures of the *Bounty* mutineers is almost endless, and many books have been written about them. The account given by Charles Nordhoff and J. N. Hall was made into a film, with Charles Laughton as Bligh.

Bourbon, House of. "The Bourbons have learnt nothing and forgotten nothing" is a famous remark attributed to Talleyrand, the crafty statesman who served these rulers of France before and after he served the Revolution and Napoleon. He had in mind Louis XVIII, brother of the guillotined Louis XVI, but, as kings of Spain and Naples, other Bourbons also tried to behave as though the Bastille had never fallen and Napoleon had never ruled.

The Bourbon family first appear as barons in the 9th century, taking their name from Bourbon l'Archambault, a village now in the department of Allier, in central France. The Bourbons grew to be powerful, but by the middle of the 13th century their lands had fallen to a single heiress. She married a son of the Duke of Burgundy, and their daughter carried the Bourbon barony to her husband, Robert Count of Clermont, a son of King Louis IX of France. In 1327 the barony was made a duchy; Robert's son Louis became the first of a long line of Dukes of Bourbon. In 1505 the title passed by the marriage of another heiress, Suzanne, to her husband Charles de Montpensier; he took the title of Duke of Bourbon and became Constable of France, but quarrelled with King Francis I, took service with the emperor, and was killed at Rome in command of the imperial army which sacked the city in 1527. He left no heir, and the Bourbon lands went to a distant cousin, whose son married the Queen of Navarre. Their son was the famous King Henry of Navarre—later,

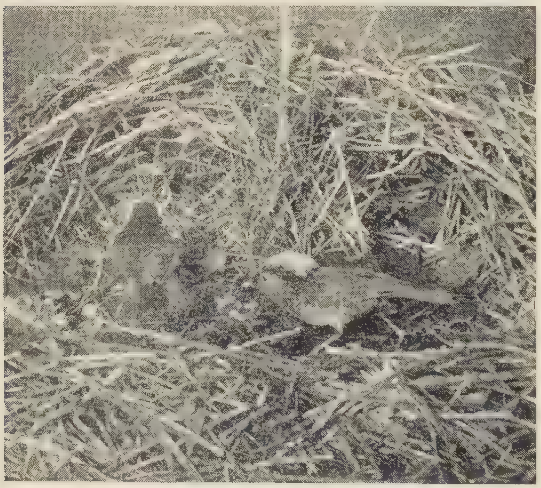
BOUGAINVILLEA LEAVES AND FLOWERS

Named after the French explorer Bougainville, bougainvillea is a climbing shrub, native to South America. The small, greenish flowers are surrounded by bright rosy bracts. The plant is grown under glass in Great Britain.

as Henry IV, the first Bourbon king of France. His descendants ruled France in direct succession, except for the Revolutionary and Napoleonic periods, until Charles X, who in 1830 was superseded on the throne by his Bourbon cousin Louis Philippe, Duke of Orleans, who was called King of the French. With the abdication of Louis Phillippe in 1848 the Bourbon rule in France ended; his great-great-grandson Henry, Count of Paris, who was born in 1908, is the present head of the dynasty, and French royalists regard him as their king. He is now able to live in France; the law of 1886 exiling the Bourbon claimants to the throne (and also the Bonaparte heirs) was revoked in 1950.

The Spanish line of Bourbon kings began in 1700 when Louis XIV of France placed one of his grandsons on the throne with the title of Philip IV. Except for the Napoleonic interval (1808–14) the crown descended in direct male line to Ferdinand VII, who died in 1833. The succession of his daughter Isabella was disputed by his younger brother Don Carlos; her reign was followed by a period of anarchy and civil war (1868–74), after which her son became king as Alfonso XII. His son Alfonso XIII, who married a granddaughter of the British Queen Victoria, was expelled from Spain in 1931. In 1941 he proclaimed his third son Don Juan "king of all the Spaniards when Spain judges it opportune." In 1947 Francisco Franco, *caudillo*, or dictator, of Spain, declared Spain a kingdom, and said that in the event of his own death or disablement a suitable member of the royal family would be called upon to rule.

The first Bourbon king of Naples was the prince who became Charles III of Spain in 1759, when he resigned Naples to his son Ferdinand. Ferdinand was driven out by his subjects in 1798, when he and his family were carried to safety by Lord Nelson and a British fleet. In the following year they restored him, but he was deposed by Napoleon in 1806. In 1815 he returned again, this time with the title of King of the Two Sicilies.



BOWER BIRD AT PLAY

Although they build their nests in trees, the bower birds have their bowers on the ground. These are built of sticks or mosses, and in them the male bird goes through all kinds of antics to "show off" to the females.

His descendants ruled until 1860, when Francis II fled and the kingdom became part of the new kingdom of Italy.

In 1748 the second son of Philip V of Spain, Don Philip, who had married the daughter of Louis XV of France, became Duke of Parma, Piacenza, and Guastalla. His descendant Charles Louis was deposed by Napoleon in 1807; after the fall of Napoleon the duchies were granted to Marie Louise, wife of the exiled emperor. On her death in 1849 they reverted to Charles Louis, whose grandson was deposed in 1860, when these territories, too, were annexed to Italy.

Famous among minor branches of the Bourbon family was that of the Princes of Condé, whose most distinguished member was Louis, called the Great Condé, a general under Louis XIII and Louis XIV. This Bourbon line was destined not to pass beyond the shadow of their great adversary Napoleon; in 1804 its heir, the young duke of Enghien, was shot by the emperor's orders in the prison of Vincennes.

Bower Bird. The bowers which gave the name to these curious birds have nothing to do with their nests. The birds make their bowers on the ground, and build their nests in trees. The bowers are actually playgrounds in which the male bird disports himself and goes through many antics in order to attract and please the females.

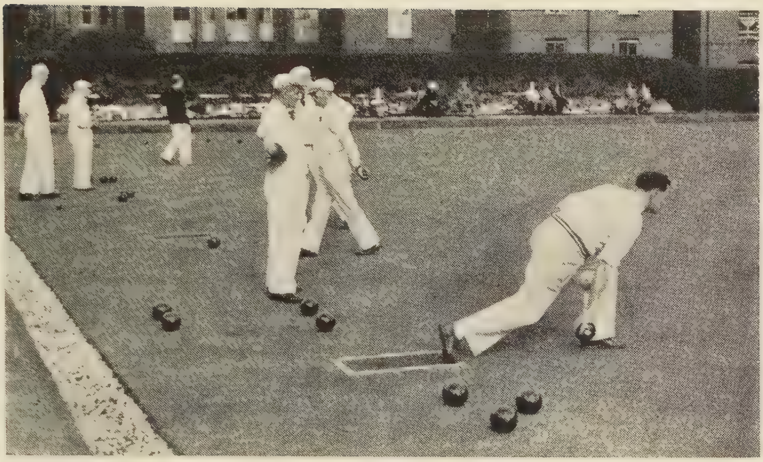
These birds are natives of Australia and New Guinea and belong to the family *Ptilonorhynchidae*, being allied to the birds of paradise (see article). There are several varieties, and their bowers vary considerably. One species constructs quite an elaborate building of sticks, sometimes eight feet in height, with little rooms, in and out of which the bower bird hops. Another builds a small house of different-coloured mosses, and surrounds it with a little lawn of moss, with here and there a flower for decoration.

Sometimes a bird more enterprising than the average ornaments its playground with feathers, shells, fruits, and even gorgeous butterflies and insects, and piles up flowers, stones, and other objects. As these decorations become faded they are removed, and replaced by fresh ones. The decorated playground of the bower bird is one of the most amazing things in nature.

Bowls. It is strange to think that such a quiet and respectable game as bowls was forbidden by law for over 300 years. The reason was that bowls, which is England's oldest outdoor sport except archery, became so popular in the Middle Ages that the young men neglected their archery to play it and the supply of skilled archers for the army began to dwindle. Bowls and some other games were therefore forbidden. Even when the archers were no longer needed, the law remained, because by then bowls had become a rowdy sport associated with taverns and drunkenness. The laws against it still stood in the time of Queen Elizabeth I, so that the game of bowls that Drake and Hawkins are said to have been playing on Plymouth Hoe when the Spanish Armada was sighted may actually have been illegal.

The game to-day consists of rolling balls called "woods," made of *lignum vitae* (with maximum circumference of 16½ in. and maximum weight of 3½ lb.), along the ground in the direction of a small

white earthenware ball called the "jack," which has been bowled up at least 25 yards away from the players' foot-mat. The woods are not perfectly spherical but are biased, *i.e.* have a slight bulge on one side which makes the wood take a curved track towards the jack. Bowling greens are superbly laid and cared-for stretches of the finest turf. In some places "crown" greens are used; these rise in the middle so that the centre may be 18 in. above the outer edges. But the level green is more usual; this is divided into "rinks" each about 20 feet wide and each forming a pitch for a separate game. In a singles game each player bowls four woods; in matches, two. A team is called a "rink" and is led by a skipper or "skip." Scoring is by points or "ends," all woods scoring that are nearer to the jack than the opponents' nearest.



BOWLS AS THE GAME IS NOW PLAYED

One of the very oldest of British games, bowls was popular in the 13th century. It began to lose favour in the 17th century, but was revived in the 20th. As seen here, several games at once can be played on one green. The finest greens are laid with Cumberland turf. The "woods" or bowls, are made of a very hard wood called lignum vitae, which comes from the West Indies.

The oldest bowling club existing—the Southampton Bowling Club—was founded in 1299. Others date back to the early 18th century. The game owes its present popularity to a revival in Scotland in the 19th century. The Scottish Bowling Association was founded in 1892; its code of rules was adopted by various English, Irish, and Welsh bodies formed around the turn of the century, and now regulates the game throughout the Commonwealth. North American bowling is a form of skittles (see article), with ten pins, and is played in ndoor "alleys."

Though primarily a man's game, bowls is sometimes played by women, who have been known to excel in it.

Boxing. At the Olympian Games of ancient Greece there were fist-fights between boxers who wore helmets of leather and gloves plated with metal. Severe injuries were usual, and there were deaths, although not often. Modern boxing has little likeness to this form of contest.

Boxing began in England early in the 18th century. James Figg, a teacher of fencing, showed his skill in boxing, a kind of fencing with the fists. This new sport became popular, and fights for money stakes (or prize-fights) drew big crowds, although they were against the law. At the end of the century came the great days of the English prize ring. Men were carefully trained to meet in the "ring," a roped-off square, usually marked out in a field. Fights went to a finish, that is, until one of the pair was unable to continue.

A round ended when one of the boxers fell to the ground, whether after many minutes, or after only a few seconds. When a round ended, the seconds took their men to their corners and attended them during an interval of half a minute. After this pause, the boxers again came "to the scratch," and set to. If either failed to stand up after thirty seconds the fight was over, the loser being "knocked out of time."

Boxing with bare knuckles was a matter of straight hitting with both right and left. Foot movements were not as free as in modern boxing.

Turf was underfoot, and it was usual to wear shoes with spikes or studs. The men stood close, and were allowed to grapple and throw one another to the ground. When padded gloves were adopted for contests, hooking, swinging, and uppercutting were brought into play. Faster and more varied footwork came into use with the springy surface of the modern ring.

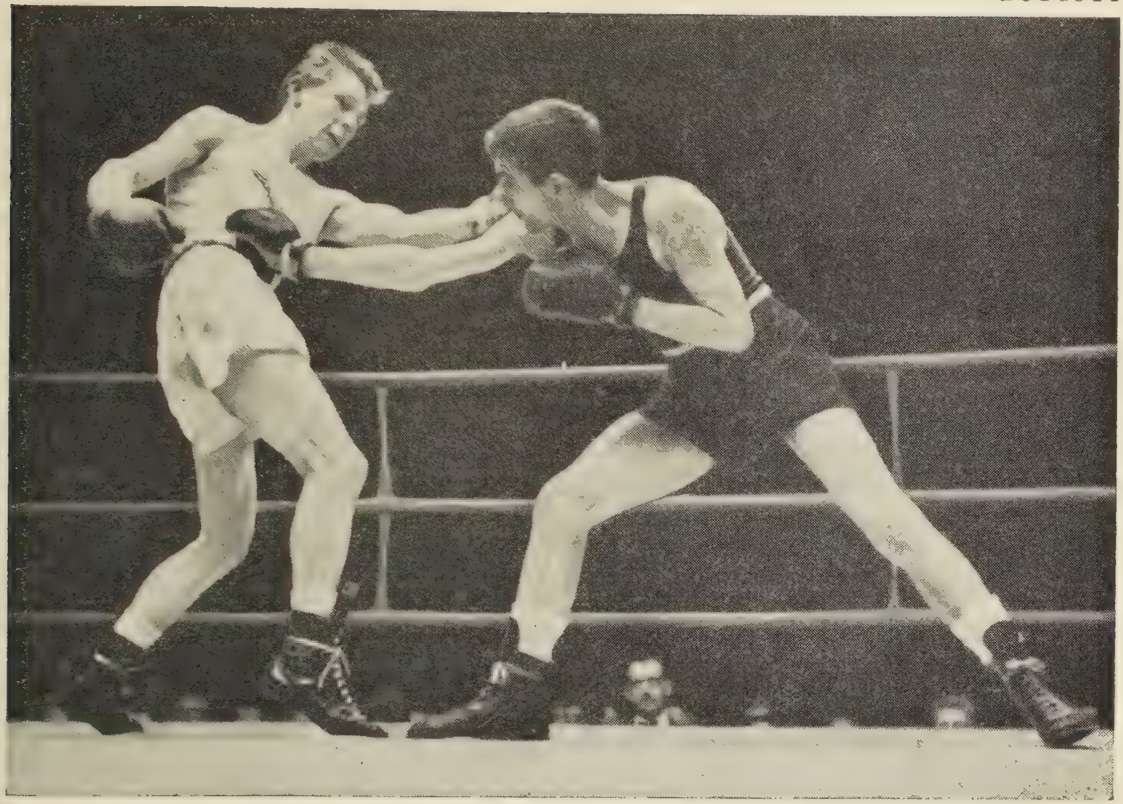
The prize ring was at its height until Waterloo year (1815) or a little later. Then John Jackson, Jem Belcher, Hen Pearce, and Tom Cribb were the most famous sportsmen in England. Later in the 19th century the prize ring lost the fashionable supporters who had encouraged it in the time of the Napoleonic wars, and it fell on bad days. Yet even in 1860 the fight at Farnborough between the English champion Tom Sayers and John C. Heenan of America, was watched by a large crowd, and fully reported in English and American newspapers.

Modern boxing rules are based on those drawn up in 1867 by the 8th Marquess of Queensberry. They provide for the use of padded gloves, now weighing six or eight ounces each. Fair play is ensured by rules that limit hitting to the front of head and body, and blows "below the belt" are foul. Punching must be done with the knuckle part of the closed glove, and both hands must be free; that is, it is forbidden to hit with one hand while holding with the other. Butting and wrestling are barred.

Matches are made for a fixed number of rounds, each lasting three minutes, the end of a round being marked by the ringing of a bell for a minute's interval. At the end of a match the referee decides the winner, counting up points for such qualities as clean punching, defence, and attack.

A bout may be stopped before the completion of the arranged number of rounds, should one of the boxers be unable, through injury, to continue; or

Boxing demands not only physical fitness and agility, but also a quick brain and a knowledge that can be acquired only by practice. Training to get into condition and to be fighting fit includes the use of various devices (1, 2, 4) to develop certain muscles and to accelerate the co-ordination between hands and eyes. Running and walking on the road strengthens the legs and improves the wind. Sparring (3, 5) develops tactics and the ability to make use of the ring.



AMATEUR BOXER TAKING EVASIVE ACTION

Professional boxers wear only trunks, but amateurs also wear vests in the ring. The man on the right has led with his right to the body, and his opponent is swaying away from the punch. From the stance it is clear that the boxer in the dark trunks boxes with his right hand leading, and so is what is called a "southpaw."

if he should be "knocked out," that is, unable to rise within ten seconds after being knocked off his feet. When this happens obviously the fight is won by the other boxer. A boxer using foul methods may be disqualified in favour of his opponent. If the referee thinks that the men are equally matched, he will call the bout a draw. This is very rare

From early days in the prize ring men were roughly classified by weight, for example, as light-weights and middle-weights. In modern boxing, weight classes are exactly fixed. For professionals there are eight classes : fly-weight (limit 8 stone) ; bantam-weight (limit 8 stone, 6 lb.) ; feather-weight (limit 9 stone) ; light-weight (limit 9 stone, 9 lb.) ; welter-weight (limit 10 stone, 7 lb.) ; middle-weight (limit 11 stone, 6 lb.) ; light-heavyweight (limit 12 stone, 7 lb.) ; heavy-weight (no upper limit).

To these eight classes, two have recently been added for amateur championships : light-welter-weight, and light-middleweight.

The modern age of boxing began with the American champion John L. Sullivan. In the last championship fight with bare fists he beat Jake Kilrain in 75 rounds near New Orleans in 1889. In 1892, in the first championship fight fought with gloves, he lost at New Orleans to James J. Corbett in 21 rounds. All championship matches since then have been decided with gloves. As boxing became less brutal, it came to be permitted by the law, and championship matches have drawn large crowds. When Jack Dempsey lost to Gene Tunney at Chicago in 1927 more than 100,000 people paid over $2,500,000 to attend.

Most boxers stand "on guard" with left foot and left hand forward. They lead with the left hand, following, when an opening occurs, with the right. "Counter-punching" is a reply to an opponent's lead. "In-fighting" is boxing at close quarters, directed mainly against the body. The uppercut is a short punch, delivered, from a bent arm, usually against the chin. When two boxers come to holds, they are said to be in a clinch, and will be ordered by the referee to "break."

Boxers who stand right-foot forward are now called "southpaws," the name being borrowed from the American game of baseball.

As a sport, boxing is one of the healthiest and most vigorous of exercises. It requires a high degree of physical fitness, endurance, skill, and control of the temper.

Boycott. A number of words in common use in the English language were originally the names of people. Some examples are sandwich, mackintosh, brougham, cardigan, quisling, shrapnel, macadam, and watt. One of the most firmly established is "boycott," meaning to combine against a man (or group of men) by refusing to deal with him, to buy from him, to sell to him, or to have any social relations with him at all. It dates

from 1880, when Ireland was in the midst of a great land struggle, with its demand for the "three F's"—fixity of tenure, or the right of the tenant to keep his land as long as he paid the rent for it; free sale, or the right to sell his interest in the land to whom he wished; and fair rent, which would prevent the landlord from raising the rent unjustly. To enforce these demands the Irish Land League was formed, the members of which agreed that any landlord or agent who refused to grant their demands should be "isolated from his kind as if he had been a leper of old."

Captain Charles Cunningham Boycott (1832–97) was the agent for the Earl of Erne's estates in County Mayo. He refused to fix rents at terms demanded by the tenants, and was the first victim of the Irish Land League. The population for miles around would have nothing to do with him or his family. His servants were coaxed or driven away, his food supplies interfered with, and his fences torn down. A force of 900 soldiers was needed to protect the men from Ulster who harvested his crops, but he was finally reduced to such dire straits that he had to leave the country.

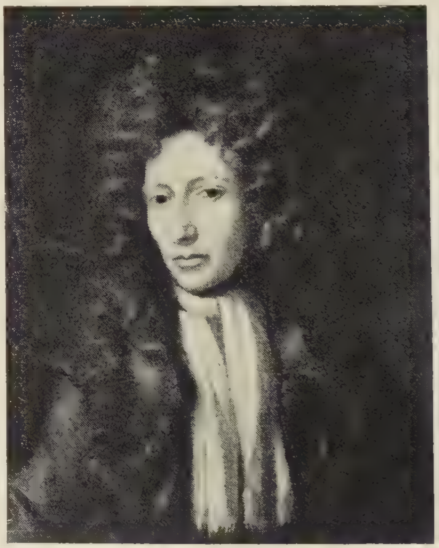
The word "boycott" soon passed into the English language, and spread to many others. Indeed the verb "to boycott" is found in Modern Greek as *mpoukotadzein* (bōōkotad′zīn), and in Russian as *boikotirovat* (boikotē′rovat).

Boyle, ROBERT (1627–91). This famous scientist, often described as "the father of chemistry," devoted the whole of his life to acquiring scientific knowledge. He was born at Lismore in Munster, Ireland, the 14th child of the first Earl of Cork, and went to Eton. Even as a young man his main interests were chemistry and natural science.

He conducted experiments at his manor house of Stalbridge, in Dorset, and at Oxford, where he lived for many years. He was one of the original members of the "Invisible College" (a group of men anxious to increase their scientific knowledge), which in 1662 became the Royal Society of London. It was his principle not to accept any fact in chemistry, or any theory, until he had proved it by experiments of his own. His work has been said to mark the change-over from alchemy to chemistry, and in the vast range of his discoveries were many that contributed materially to scientific knowledge, notably the principle relating to the pressure and volume of gases, known as "Boyle's Law." His theories of the science of chemistry are embodied in his *Sceptical Chymist* (1661), one of the great books in the history of scientific thought.

Combustion, respiration, air-pumps, colours, electricity, the expanding force of ice, and many other profound studies, he explored with patient perseverance; but, as he himself confessed, he was too tender-hearted to persist with experiments on living animals. Always deeply interested in religion, he left provision in his will to found the annual Boyle Lectures in defence of Christianity.

Boyle's Law states that the pressure which a quantity of gas exerts against the walls of the vessel that contains it is inversely proportional to the volume occupied by the gas, so long as the temperature remains constant. Thus if a gas is squeezed into half its volume the pressure is doubled, and so on. Boyle's Law would be exactly true for an "ideal gas" in which the molecules occupied no space themselves and exercised no attraction on each other. It is only approximately true for real gases (see article).



National Portrait Gallery

ROBERT BOYLE

This British scientist, described as "the father of chemistry," formulated the law relating to gases which is named after him. This portrait is after Frederic Kasseboom.

Boyne, BATTLE OF THE (1690). When James II was driven from England in 1688 he hoped to regain a footing in Ireland at least. So the following year he landed there with an army. But the Protestants in Ulster resisted him stubbornly and he besieged Londonderry without success. In 1690 William III himself landed at Carrickfergus, and at Belfast put himself at the head of his army. It consisted of English, Scots, Irish, French Huguenots, Dutch, Germans, and Danes. James's troops were mostly French and Irish. William marched southward towards Dublin and met James's forces (about 25,000 men) drawn up on Donore Hill, a low ridge to the south of the river Boyne some two or three miles west of Drogheda on the evening of June 30 (old style—*see* CALENDAR). William's force of about 36,000 encamped on Tullyesker Hill, a ridge to the north of the Boyne and opposite James's forces. Early next morning (July 1) while reconnoitring, William was slightly wounded.

The battle began when William's army crossed the river at four places. Ten thousand men crossed at Slane, four miles to the west, and so were able to attack James's men on the flank. The rest of William's army delivered a frontal attack. Both sides fought well, and William showed great bravery in leading his party across the river Boyne under heavy fire. Towards evening the Irish beat a retreat and James fled to France once more.

Although local fighting continued in Ireland for more than a year, the Battle of the Boyne marked the end of any hopes James II might have had of regaining his throne. William's troops won another decisive victory at Aughrim on July 12 of the following year. Both battles are commemorated on "Orangemen's Day," celebrated with great enthusiasm on July 12 in Protestant Ulster, and so called in memory of the Protestant champion William of Orange—though the use of the name "Orangemen," as well as the annual holiday, is of much later date than these events.

GOOD CITIZENS *in the* MAKING

Boy Scouts. The Boy Scout movement was founded in 1908 by Lieut.-Gen. Sir Robert Baden-Powell (see article), a well-known army scout with experiences in Africa and India, and hero of the siege of Mafeking. He became impressed with the usefulness of scouting as training in good citizenship, and in 1907 he gathered together a group of 20 boys, drawn from all classes of society, in an experimental camp on Brownsea Island, in Poole Harbour, near Bournemouth. This camp proved that his scheme of scouting for boys was not only practical but overwhelmingly successful. In January 1908 the first part of his book *Scouting for Boys* was published, the other five parts following at fortnightly intervals.

Up to that time "B.-P." had no intention of starting a new boys' organization but intended that the ideas in his book should be used as attractive additions to the programmes of existing organizations such as the Boys' Brigade and the Y.M.C.A. But soon after the appearance of *Scouting for Boys*, boys all over the country began forming themselves into "patrols," doing the things suggested in the book, and calling themselves Boy Scouts. There was nothing for it but to set up an organization to cope with the situation. In 1910, by which time the movement had grown tremendously and was spreading to many other countries, "B.-P." retired from the army to devote all his time and all his talents to helping young people.

He resolved to put life and colour into his new movement, adopted the easy-fitting, picturesque uniform now so familiar, and by stirring up a pride in themselves fired the imagination of boys with noble ideals. The appeal in scouting lies in the fact that to the boy scouting is fun, a great game played in the open air, camping, hiking, and pioneering: it is adventure and romance. The movement won success from the very first; and to-day 51 nations have their Boy Scouts (counting the entire British Commonwealth as only one country). It holds out a great attraction to boys of all classes, colours, languages, and religions.

The movement is, and always has been, wholly non-military. It does not attempt to make soldiers of boys, although all forms of manly recreation and occupation are followed. Its great aim is first and foremost to create good citizens.

RAISING FUNDS FOR THE SCOUTS
Every year the Boy Scouts of the United Kingdom hold a "bob-a-job" week, during which time they will undertake any task for a shilling. Nothing comes amiss so long as they can earn money for the Boy Scouts.

Scouts are graded according to age. Wolf Cubs, members of the junior branch of the movement, are eight to 11 years of age. Their badge is a wolf's head, embroidered in red on a dark blue or dark green ground, and their caps are a dark green. The name "wolf" is adopted from prairie lore, for the Red Indians, pioneers of scouting, gave the title to their best and bravest members. The Cub programme has drawn much of its inspiration from the *Jungle Books of* Rudyard Kipling.

Next to Wolf Cubs come the Boy Scouts, boys of 11 to 15; then Senior Scouts, from 15 to 18; while the Rover Scouts are over 18 years. There are Sea and Air Scouts, Deep Sea Scouts (scouts who are in the Royal Navy or Merchant Navy), and Handicapped Scouts, for whom special training is given. Handicapped Scouts have physical or mental deformities; and valuable service has been done for them in hospitals, the boys being taught handicrafts and given an additional interest in life.

Wolf Cubs are organized in packs, and the leader is called a Cubmaster. A pack usually consists of 18 to 24 Cubs, and the cubs are divided into sixes—six cubs under a leader known as a Sixer. The beginner is known as a Recruit until he has mastered the Cub laws and passed a series of simple tests, after which he becomes a Tenderpad and is entitled to wear Cub uniform. By passing graduated tests a Cub is able to gain his much-coveted first and second stars.

How to Become a Scout

To become a fully-fledged scout a boy must be 11 years of age. Some boys join the scouts direct, provided they have reached the prescribed age, while others start as Wolf Cubs. The scout becomes the member of a patrol consisting of five to eight boys. Two or more patrols constitute a troop. After satisfying his scoutmaster that he knows and understands the scout promise and law, and has passed the few simple tests, the recruit becomes a Tenderfoot, is invested into the troop, and is entitled to wear the uniform and badge of a scout. Members of the troop have a large part to play in the running of the troop through a committee consisting of scouters (*i.e.* scoutmasters, cubmasters, etc.) and patrol leaders.

After gaining his tenderfoot badge, the scout can work for second-class and first-class badges by

qualifying in many different aspects of scoutcraft. The highest attainment is the Queen's Scout badge.

The scoutmaster is the leader of the troop. He must be a man of good moral influence, capable of leadership, and possessing qualities that appeal to the boys, such as a cheery disposition and sportsmanlike gifts. Scoutmasters are encouraged to undertake training courses at Gilwell Park, Chingford, Essex, and at other training centres.

YOUNG SCOUT AS BRICKLAYER'S MATE

Scouts must be prepared to turn their hands to anything, even to help in the building of their own headquarters. The 3rd Kingsbury Troop, North London, undertook the rough, unskilled work to assist the volunteer bricklayers and carpenters, and also raised money by collecting and selling jam jars, and organizing dances.

All scouts promise on their honour to carry out the Scout Law, which has ten clauses, some of which are: "A scout's honour is to be trusted"; "A scout is loyal to the Queen and his country, to his scouters, his parents, his employers, and those under him"; "A scout's duty is to be useful and to help others"; "A scout is a friend to all and a brother to every other scout"; "A scout is clean in thought, word, and deed."

The scout, with his distinctive dress of shirt, shorts, beret or frontiersman hat, neckerchief, and fleur-de-lys badge, is not only learning interesting things all the time but is learning to be a good

FORESTERS DEALING WITH A FELLED TREE

Among the collective badges for scouts over 15 is that of Countryman, and to qualify for it the recipient, among several other things, must be a forester. During the Second World War, when wood was so urgently needed for many purposes in the United Kingdom, scouts felled and trimmed trees for the national war effort. Having no transport, they solved the problem of hauling timber out of the woods by acting as their own logging team.

AIR SCOUTS STUDYING REAL AND MODEL AIRCRAFT

The Air Scouts were formed in 1941 and officially recognized by the Air Ministry in 1950. They receive instruction at service aerodromes, and these scouts are hearing about the performance of a biplane flown by naval aviators during the Second World War. Air Scouts with first-class badges may fly as passengers in Service aircraft, if they have permission from their parents and the Association. There are some 3,000 of them in the United Kingdom.

Boy Scouts Association

These Air Scouts are studying models of aeroplanes and gliders in order to be able to recognize real aircraft when seen in flight. They undergo the same basic training as ordinary scouts, and are eligible for the same proficiency badges. A blue beret is worn by Air Scouts, and in 1950 a special badge was designed for them by the Air Ministry, the devices used being an eagle in gold above a red, white, and blue roundel upon a background of Royal Air Force blue.

SEA SCOUTS LEARNING TO BE HANDY MEN

Boy Scouts Association

Members of the nautical section of the boy scout movement are known as Sea Scouts, and, like the Air Scouts, have the same initial training as ordinary scouts. In addition they take part in specialised marine activities, such as the handling of boats (top picture), navigating, reading a chart, and splicing ropes (lower). From 1937 to 1953 Sea Scouts used Captain Scott's ship *Discovery*, moored off the Victoria Embankment, London, as a training ship.

BADGES TO BE EARNED BY BOY SCOUTS

To face page 40, Vol. 2

BADGES OF MERIT FOR SENIOR SCOUTS

Badges for Scouts over 15


Air Observer


Ambulance


Dispatch Rider


Pilot


Handyman

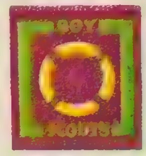

Interpreter


Leading Signaller


Public Health


Fireman


Pathfinder


Rescuer

Collective Badges for Scouts over 15


Athlete

Climber
Master Swimmer
Venturer


Aviator

Aircraft Constructor
Air Glider
Air Mechanic
Air Navigator


Countryman

Farmer
Fisherman
Forester
Horseman
Horticulturist
Naturalist


Craftsman

Artist
Handicraft
Leading Piper
Musician
Orator
Philatelist
Photographer
Reader


Scientist

Astronomer
Electrician
Mechanic
Meteorologist
Radio Mechanic

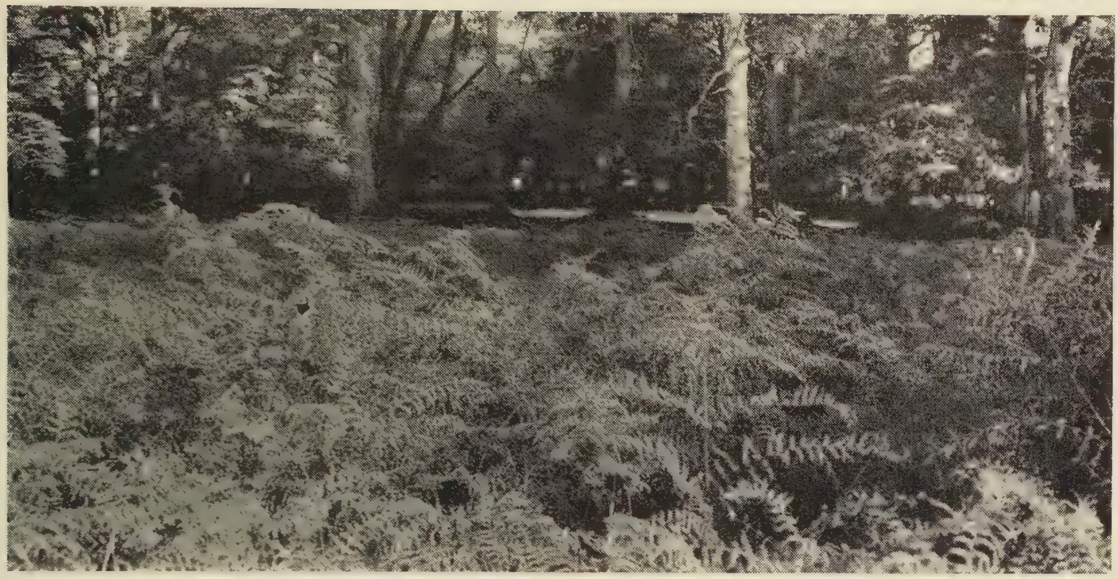

Open-Air

Camp Warden
Hiker
Map Maker
Master Cook
Pioneer
Tracker


Mariner

Boatswain
Helmsmar


Queen's Scout Badge



H. & V. Joel

BRACKEN IN THE WOODS

Bracken fern will grow on any well-drained soil, particularly in rather open woods (above), and on hill pastures. The frond on the right had its tip caught in a root as it began to uncurl, and the stem has been bent double. The leaves or fronds take three years to reach full size, but live only six months above ground.

citizen. He has sworn to keep a noble code of law, and he will live up to the fine motto, "Be Prepared," which means that scouts must always be ready to meet any emergency promptly, efficiently, and where necessary courageously.

Scouts are taught many useful occupations and are encouraged to qualify for a large number of badges for proficiency, some of which are shown in the accompanying colour plate. Among other awards are medals for gallantry and courage in the face of great suffering. The Boy Scouts Association is administered by a council. Each county is under a county commissioner and county scout council, and is subdivided into districts, each under its own commissioner. In 1956 the total world membership of Scouts was nearly 7,000,000 with 532,388 in Great Britain alone.

Every four years, world jamborees are held. These are great international camps forming a basis on which youth of the world can meet in friendship and harmony. When the first jamboree was held in 1920 at Olympia, London, King George V, in a message to the Chief Scout, said: "I am fully alive to the great benefits, both moral and physical, which the boys scouts' training assures, and recognize the admirable results already achieved under your direction."

The Boy Scouts Association was incorporated by royal charter in 1912. This "incorporation" conferred the privilege of buying and owning property, although the association is supported by voluntary subscriptions only. Lord Rowallan (born 1895) became 3rd Chief Scout of the British Commonwealth in 1945. The imperial headquarters are at 25, Buckingham Palace Road, London, S.W.1. (*See also* Girl Guides.)

Bracken. Many a hill pasture or grassy common is partly covered with the great, lacy, triangular fronds of the bracken fern, which also grows in woods that are not too shady. It is a beautiful plant, especially in spring shades. Its scientific name, *Pteridium aquilinum*, means "eagle fern," so do its French and German names. In Sweden any fern is called "braken," the Old English name for bracken. It lives for many years, spreading by tough rhizomes (stems creeping underground) which may be a yard or more below the surface, so no wonder farmers find it very difficult to get rid of! In spring these burrowing stems send up beautifully curled green leaves shaped like bishops' croziers and covered with golden-brown scales. The leaves or fronds take three years to form but live only six months above the ground. When they uncurl, each opens many leaflets, and each leaflet consists of a miniature fern "leaf." On rich soil bracken may grow six feet high. It has tiny brown spores on the backs of the leaflets instead of seeds, and in autumn the fronds turn yellow, then golden, and finally dull brown.

Bracken in pastures not only starves the grass under it, but is poisonous to horses and cattle. Sheep can eat a certain amount without harm,

and help to check its spread. It makes good bedding for farm animals where straw is scarce, and bracken gathering goes on in the New Forest by royal permission. Farmyard manure or compost made from bracken is a good potash fertiliser, and the potash in the ashes of bracken leaves was used in the Middle Ages for making soap and glass. A soft, springy packing for china and glass is provided by dry bracken. (*See* FERNS.)

Bradford. Quite possibly the clothes you are wearing have been in Bradford at some stage of their manufacture, for that busy city in the West Riding of Yorkshire is the chief centre of the wool and worsted trade.

Bradford has been connected with the cloth trade from very early times; but it was not until the invention of power looms and other machinery that it began its rise to the proud position it now holds—that of the greatest wool-working centre in the country. Bradford's first spinning-mill was founded in 1798, when the population was only 10,000. A century and a half later, at the census of 1951, it was 292,394. Not only wool but other textiles are now produced there on a considerable scale —silks, velvets, cottons, mohair, and alpacas. Iron and coal are worked in the neighbourhood, and the city has large engineering works and foundries.

If Bradford strikes the visitor as being a "grey" city, it is not only because of the smoke of industry but because most of the houses and other buildings are built of brown-grey stone. The centre of the city lies in a side-valley of Airedale, whence buildings stretch outwards up the surrounding hills to meet those of other great centres of industry, including its larger neighbour, the city of Leeds. Yet the workers of Bradford have almost on their doorsteps plenty of wild, open moorland country, as well as many magnificent parks within the city boundary.

Bradford was made a city in 1897, and has been a cathedral city since 1919. Its grammar school, founded in the 16th century and moved to a new building in 1873, has a national reputation. Bradford is also proud of the unusual number of famous men who were born there. They include Sir Edward Appleton, the physicist; Sir Douglas Mawson, the Antarctic explorer; Frederick Delius, the composer; Sir William Rothenstein, the artist; Humbert Wolfe, the poet; and J. B. Priestley, the playwright and novelist.

Bradshaw, GEORGE (1801–1853). In most offices and many private houses the bulky volume of "Bradshaw" is among reference books within easy reach. Its slender ancestor, the first railway guide ever published, was brought out in 1839 by the enterprise of George Bradshaw, a Manchester printer and map-engraver. It was called *Bradshaw's Railway Time Table*, but the title was changed, the following year, to *Bradshaw's Railway Companion*—a book of 32 pages and no advertisements. In 1841 the guide began to be issued monthly, for Bradshaw had accomplished the difficult task of persuading the railway companies to adjust their schedules for the beginning of each month. In 1847 *Bradshaw's Continental Guide* was launched. Thus one useful and timely idea eventually made its originator's name a household word in the British Isles.

BRAHE: PIONEER ASTRONOMER

Here is an engraving of a portrait of the great Danish astronomer, surrounded by the arms of other famous Danes. The Latin inscription reads: "Portrait of Tycho Brahe, lord of Knudstrup, and founder of the citadel of Uraniborg on the island of Hven, in the Danish Sound, and inventor and maker of astronomical instruments preserved therein. Made when he was 40, in the year of Our Lord, 1586."

Bradshaw was a member of the Society of Friends (Quakers) and loved to support any project which promoted peace or the betterment of conditions for his fellow-men. He advocated universal penny postage and felt strongly about the necessity of schools for the poor: his own parents had had to sacrifice much to give him a good education.

In 1853 he visited Norway to attend an international conference on peace. When he was in Oslo (at that date called Christiania), he caught Asiatic cholera, and died within a few hours.

He would undoubtedly have been surprised to see the expansion of his ideas in the form of *Bradshaw's International Air Guide*, containing particulars of "world-wide air routes, air ports, fares, distances, foreign currencies," etc.; he might also have been flattered to know that there were once two boys who, of their own free will, and through sheer enthusiasm for trains, studied "Bradshaw" so thoroughly that they were found to have memorised the entire railway system of Great Britain. There may well be other young geniuses of this kind, as yet undiscovered, among the many boys one sees on railway stations and embankments, participating in the craze for collecting engine numbers.

Brahe, Tycho (1546–1601). When a student who has been sent to a university to study law spends his nights studying the stars instead of books, he is not likely to rise to any very lofty heights in the legal profession. Tycho Brahe failed to become a lawyer, but he became one of the most famous astronomers of his time.

Of noble family, he was born at Knudstrup, in a Baltic province that is now part of Sweden but was then ruled by Denmark. He studied law and chemistry, astronomy remaining for a while a hobby, but in 1571 he installed a laboratory at the castle of an uncle near Knudstrup, and there in 1572 discovered a new star in Cassiopeia. In 1576 Frederick II of Denmark gave him a pension and the island of Hven near Helsingör for life. On this island was built an observatory, called Uraniborg (castle of the heavens). Brahe worked there until 1597, when, his pension and fief having been withdrawn by Frederick II's successor, Christian IV, he settled for a time at Wandsbeck, near Hamburg, and at Wittenberg. He settled finally at Prague in 1599 under the patronage of Rudolph II. the Emperor, and died there in 1601.

Brahe lived at the same period as Galileo, and wrote a cordial letter to him, dated May 4, 1600, but the two great astronomers never met. The Dane was a very remarkable man considering that he lived in an age when astronomers were still superstitious believers in astrology. He himself clung to the beliefs of his age. For example, in spite of the fact that his measurements amply confirmed those of Copernicus, he refused to believe Copernicus's theories, and maintained to the end of his life that the Earth was the centre of the universe, and that the sun revolved round it. He even asserted that it was an offence against religion to believe otherwise.

While the system of the movements of the planets which he worked out, and which bears his name (the Tychonic system), was proved later to be based on fallacies, the labours and observations of Brahe helped to pave the way for the greater astronomers who followed him. The 400th anniversary of his birthday, December 14, was enthusiastically celebrated in Denmark in 1946.

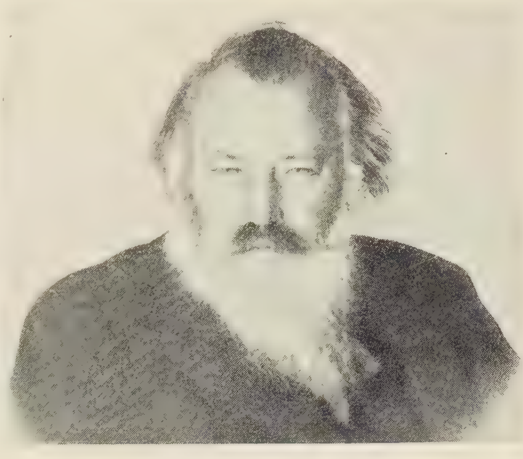
Brahms, Johannes (1833–97). In the middle of the 19th century, when musicians were arguing whether old forms of music were " worn out " and some new forms needed, one composer Johannes Brahms, wrote works which seemed to answer the question in favour of both sides. Followers of the classical forms could claim that he kept strictly to their rules in musical structure. Innovators could claim that he achieved entirely new effects, and hence had broken with older ways. But many agreed in grouping Bach, Beethoven, and Brahms as the supreme masters.

Brahms was born in Hamburg, Germany, on May 7, 1833. His father played the double-bass in an orchestra; his mother kept a little shop to eke out the family's limited income. At the age of eight, young Brahms began his lessons in piano playing. Soon afterwards his talent led a celebrated teacher, Marxsen, to instruct him without pay. At the age of 11 he made his first attempts at composition, and at 15 he gave his first concert in Hamburg. At one time he had to help support himself by working as a dance-hall pianist. When 20 years old he made a concert tour as accompanist to the celebrated Hungarian violinist Reményi, and met the violinist Joachim, who gave him a letter to Robert Schumann. Brahms played his Sonata in C Major and other early works to the older composer, who thereupon published an enthusiastic article which made the young man known to German musicians.

In 1854 Brahms accepted a position with the Prince of Lippe-Detmold. There he had considerable time free for composition. Schumann died in 1856 but Madame Clara Schumann, who was a well-known pianist, introduced Brahms's compositions to a wide public and remained a life-long friend.

In 1862 Brahms paid his first visit to Vienna, where, except for an occasional short visit abroad, he remained to the end of his life. In 1863 he became conductor of the *Singakademie* (College of Singing), and in 1872 he accepted the post of director of the Concerts of the Society of Friends of Music. In 1875 he resigned this position and thereafter kept himself entirely free for composition. He received a degree from Breslau University, and wrote for his thesis the gay "Academic Festival" Overture, which is based on students' songs. Brahms never married. He died in Vienna.

Brahms was a sturdy, large-framed man of placid bearing and serene temper, quite unmindful of popular approval. As a composer he wrote slowly and was severely self-critical. His technique was perfected gradually, but some of his later music lacks the vitality of his youthful inspiration. Brahms's compositions include works of almost every class except opera. Among the most important are the " German Requiem " for choir and orchestra, four symphonies, four concertos (two for piano, one for violin, and one for violin and 'cello), symphonic variations, serenades, overtures, and chamber music. Among nearly 200 songs are some of great beauty, the " Cradle Song " being a special favourite.



JOHANNES BRAHMS

This photograph shows the great musician at the height of his fame. A brilliant composer of every kind of instrumental and vocal music except opera, he carried classical forms to a higher scale of development than they had previously reached. He ranks with the masters

The SEAT *of the* HUMAN MIND

Brain. Of all the works of creation the human brain is the most marvellous. It consists of a mass of nerve material which not only works with great skill in regulating the various movements of the body, but determines those things which are called the conscious personality, including all thoughts, feelings, desires, and hopes. During millions of years nature has been gradually improving the machinery of the nervous system in different kinds of animals until the extraordinarily delicate thinking brain of man has been produced. The brains of animals and men have been examined thousands of times and much has been learned, but the manner of their working is still unknown.

The brain as a whole is neatly packed without any waste of space in a large cavity within the bony skull or cranium. The brain material does not actually come into contact with the bone, but is protected by three layers or linings one above another, called meninges.

Three distinct parts, each having particular work to perform, can be recognized. The large portion, occupying all the upper and front two-thirds of the cranial cavity, is called the *cerebrum*, and is perhaps the most wonderful. Here the will, thoughts, and feelings have their origin ; here are the vast filing-cabinets of memory.

Towards the back of the head, and below the cerebrum, is the smaller brain called the *cerebellum*, the duty of which is to control what are called reflex actions. What is meant by reflex actions ? The action of balancing oneself when walking may be taken as an illustration. The variation in pressure on the soles of the feet sends messages along nerves of the body to the cerebellum, and this in turn sends messages back to the muscles that control balance. This is done unconsciously, for one may be deep in thought about something quite different. Or when a particle of dust enters the eye, causing irritation, a message is received at the cerebellum and a reply is sent to the eye, which then waters to wash out the intruder. A great variety of such reflex operations are controlled by the cerebellum.

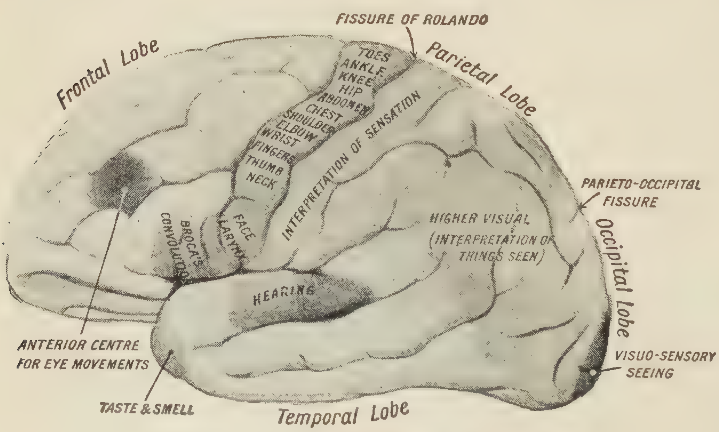
The third distinct portion of the brain is, as shown in the diagram on page 45, situated lower and more centrally at the end of that great bundle of nerves called the spinal cord, which passes up through the body to the brain. This part is called the " bulb " or *medulla oblongata*, and its work consists of regulating those organs of the body which act as automatic machines, operating day and night without our thinking anything about them. This automatic machinery includes such organs as the heart, which pumps blood through the body ; the stomach, where digestion takes place ; and the lungs, concerned with the vital gaseous interchange of oxygen and carbonic acid gas. This automatic arrangement is for man's safety and convenience. If his attention were distracted, he would forget to issue the order Heart, beat ! Lung, breathe ! and would soon be in difficulties or die. In general, mechanical movements and adjustments of the body are controlled by these two divisions of the brain, the cerebellum and the medulla.

The " Grey Matter "

The cerebrum or " large brain " is nature's crowning achievement. Dissection shows that the matter composing it is of two kinds—a rather thin outer layer of grey substance and an inner mass of white material. The grey matter is certainly the most wonderful substance of which scientists have knowledge. It consists of millions of nerve cells allied intimately with men's thoughts, emotions, memory, and other conscious processes. This layer of grey matter is the home of the intelligence, and should the substance be damaged (as in certain illnesses or accidents) the intelligence is weakened if not destroyed. " He has plenty of grey matter " is the expression used to describe a man with good intellectual power.

The substance of the large brain is folded or convoluted as though tissue paper were stuffed into a hat-box. This means that there is a much larger surface area for the grey cells to occupy than if the brain were smooth. Humble creatures such as a squirrel or a bird possess brains with smooth surfaces ; the monkey has a brain with a certain amount of infolding, but not nearly so much as man has. The degree of intelligence is in proportion to the number and depth of convolutions. The professor of mathematics has many deep convolutions ; the savage has few and shallow ones.

If consideration be given to the white substance of the

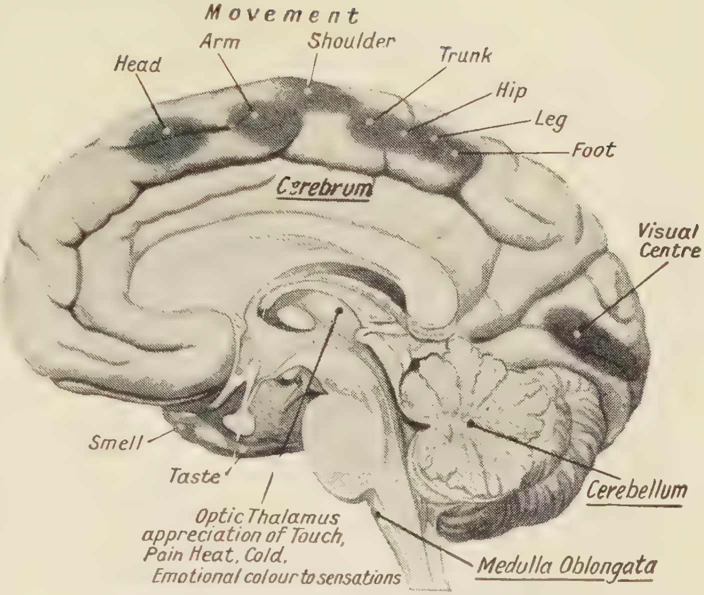


HUMAN BRAIN FROM THE OUTSIDE

In this diagram of that wonderful organ, the human brain, as seen from the left, the "centres of sensation" lie behind the "fissure of Rolando." Some of the areas known as "motor centres," where messages are translated into action, lie in front. Those for the special senses, such as sight, taste, and smell, are situated as indicated. See also illustration on page 45.

brain, it will be found that it consists of an intricate network of nerve fibres. The relation between the grey and white substances appears to be that the grey cells are the *operators* which play upon the white fibres, causing them to transmit suitable messages to various parts of the body.

The similarity of the brain to a telephone exchange is very striking. All parts of the body are supplied with nerves which correspond to telephone wires, and these nerves are connected with the brain by means of the spinal cord. The way in which brain messages work may be illustrated by reference to the eye. When this organ sees anything, an approaching motor-car, for instance, a picture is formed on the sensitive nervous screen at the back of the eye and a message is sent to the area at the back of the cerebrum where the control of vision is located. Here the picture message is "interpreted." Instantly this area sends a message along the correct nerves to the muscles of the legs, with the result that you dodge the motor-car.



THE BRAIN'S RIGHT-HAND HALF EXPOSED

This diagram of the right half of the brain indicates the positions of various control areas. The regions marked at the top are centres of movement, or "motor centres," extending forward from the "fissure of Rolando."

Just as vision is interpreted by an area at the back of the brain (the eye being just a "camera lens" that catches and transmits the image), so other areas of the brain are known to control certain functions. Some control the limbs, others the face, another the power of writing, another the power of speech. Thus when the speech centre is destroyed by injury or disease, a man can write but cannot speak. If the writing centre is destroyed, he can speak but is unable to write. Certain areas of the brain, known as "silent" areas, do not seem to have any particular function. It is well known that the right side of the brain controls the left side of the body, and vice versa.

Personality and Memory

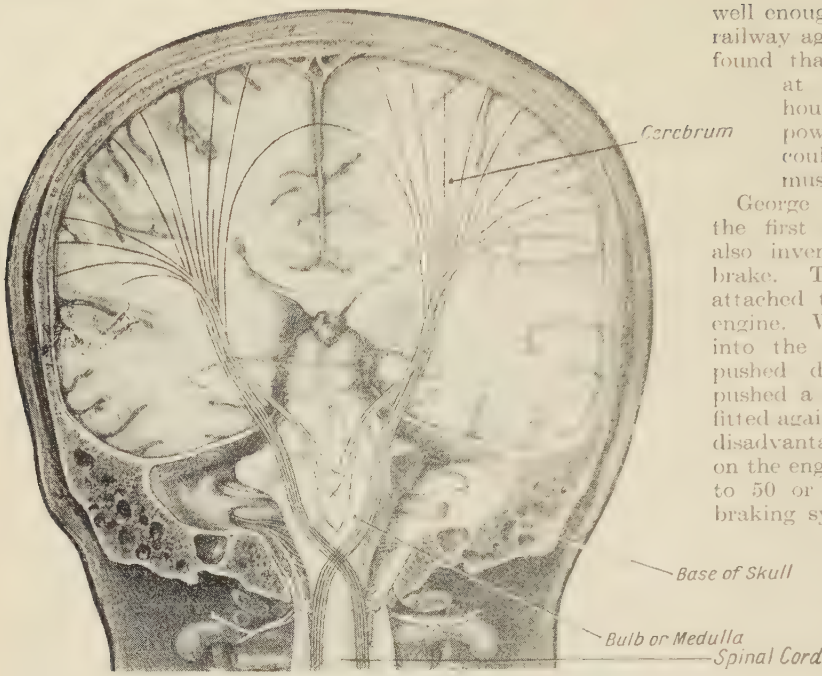
In this intricate "telephone system" it is obvious that the operators require food and rest, and that the wires need repair. A complicated system of blood-vessels branches throughout the brain, feeding the countless nerve-cells ; and sleep gives the cells a chance for rest and repair. Of the nature of sleep very little is known ; it may be caused by a lessened supply of oxygen to the brain, or by an accumulation of the products of energy in the tissues causing a temporary toxaemia.

When you look at a man's face it frequently happens that you like him or you do not. Why do you feel this sense of attraction or repulsion ? When the embryo is only a few weeks old, its outer layers turn inwards to form the brain and the central nervous system. Thus, when you look at a man's face, you see tissues which are developing continuously with those housing his personality. Perhaps the answer may lie here.

More and more "robots" are being invented —mechanical machines that answer to stimuli of sound and of light and can perform many feats almost as though alive, even to the extent of playing chess with a human opponent (*see* CALCULATING MACHINES). But they are by no means "almost human." The mark of being human is not to possess a brain but to be conscious of self, and the relation of brain activity to consciousness is a complete mystery. This is a problem entirely different from chemical changes in the retina of the eye, and resulting in sight ; or of currents passing up the nerve of hearing, and resulting in sound. The eventual understanding of consciousness will leave mechanics very far behind.

Memory (see article), the more it is considered, becomes the more amazing. It is not known how it works. Where are these countless records kept ? A sound, a scent, will at once cause to flash vividly before you a scene, a delight, a distress "forgotten" completely for years. Scent is perhaps the most powerful of these stimuli to recollection. "Scent is stronger than sight or sound to make your heart strings crack," wrote Rudyard Kipling. This is because scent is the oldest sense. As man's early animal forerunners climbed out of the primordial slime, they had to sniff hard to get their dinner, or to avoid becoming a dinner for a bigger rival. No experience important to the individual passes completely from the mind, whether or not it received much attention at the time.

A child has usually a far more efficient memory than an adult, because he is less burdened by experience and the original impressions are sharper ; but even a child's memory retains from his experience only what seems to him important, and lets the rest go. In speaking of memory the great Viennese psychologist Sigmund Freud (see article) must be mentioned. He it was who first claimed that there is no such thing as "forgetting." Nothing, however trivial, can happen to you without becoming part of you for ever. But life would be



"TELEPHONE EXCHANGE" INSIDE THE HUMAN HEAD

This is what the brain looks like when seen in vertical cross-section behind the ears. The "telephone exchange" of the brain is constantly at work receiving and transmitting messages to all parts of the body by nerves passing through the spinal cord.

impossible if the awkward or painful situation always haunted you, and so you "repress" it, thrusting it down unconsciously into a deep layer of the mind. There, however, according to Freud, it can sometimes burrow underground, perhaps rendering you sleepless, irritable, and nervous. But let it once be brought up into consciousness and recognized for what it is, and it will usually become stingless and harmless.

When all the knowledge of the scientists and anatomists is put together, there is still no answer to the main question of how the brain works. Are thought and consciousness a product of the grey cells of the brain? Or do they merely use the grey cells somewhat in the same manner as an electric current uses a conducting wire? Perhaps some readers, belonging to the coming generation of physiologists and neurologists, may themselves provide an answer in future years.

Brakes. When all land transport was drawn by horses, brakes were far less important than they are in the motor age. A cart or carriage travelling at about eight miles an hour could be stopped very quickly; and indeed the chief use of brakes on horsed vehicles was to prevent the carriage from overrunning the horses when going downhill. A wooden or metal "shoe" placed under one rear wheel was usually enough.

With the coming of fast mail coaches towards the close of the 18th century, it became more necessary to devise some method of stopping quickly. Accordingly, brake-blocks were introduced, consisting of pieces of curved wood fitting against the rims of the rear wheels, and worked by a handle on the driving-seat. These served well enough until the coming of the railway age after 1825. It was soon found that railway trains, moving at more than 20 miles an hour, required brakes far more powerful than anything that could be controlled by human muscles.

George Stephenson, who designed the first practical railway engine, also invented the first mechanical brake. This consisted of a lever attached to a piston on the steam engine. When steam was admitted into the cylinder, the piston was pushed down, and this in turn pushed a lever connected to blocks fitted against the wheels. One of its disadvantages was that it acted only on the engine wheels. As speeds rose to 50 or 60 miles an hour, some braking system was required which would simultaneously act on the wheels of the engine and of all the coaches. George Westinghouse (1846–1914), an American railway engineer, introduced the first really efficient continuous train-brake in 1887. It came to be used on most of the world's railways.

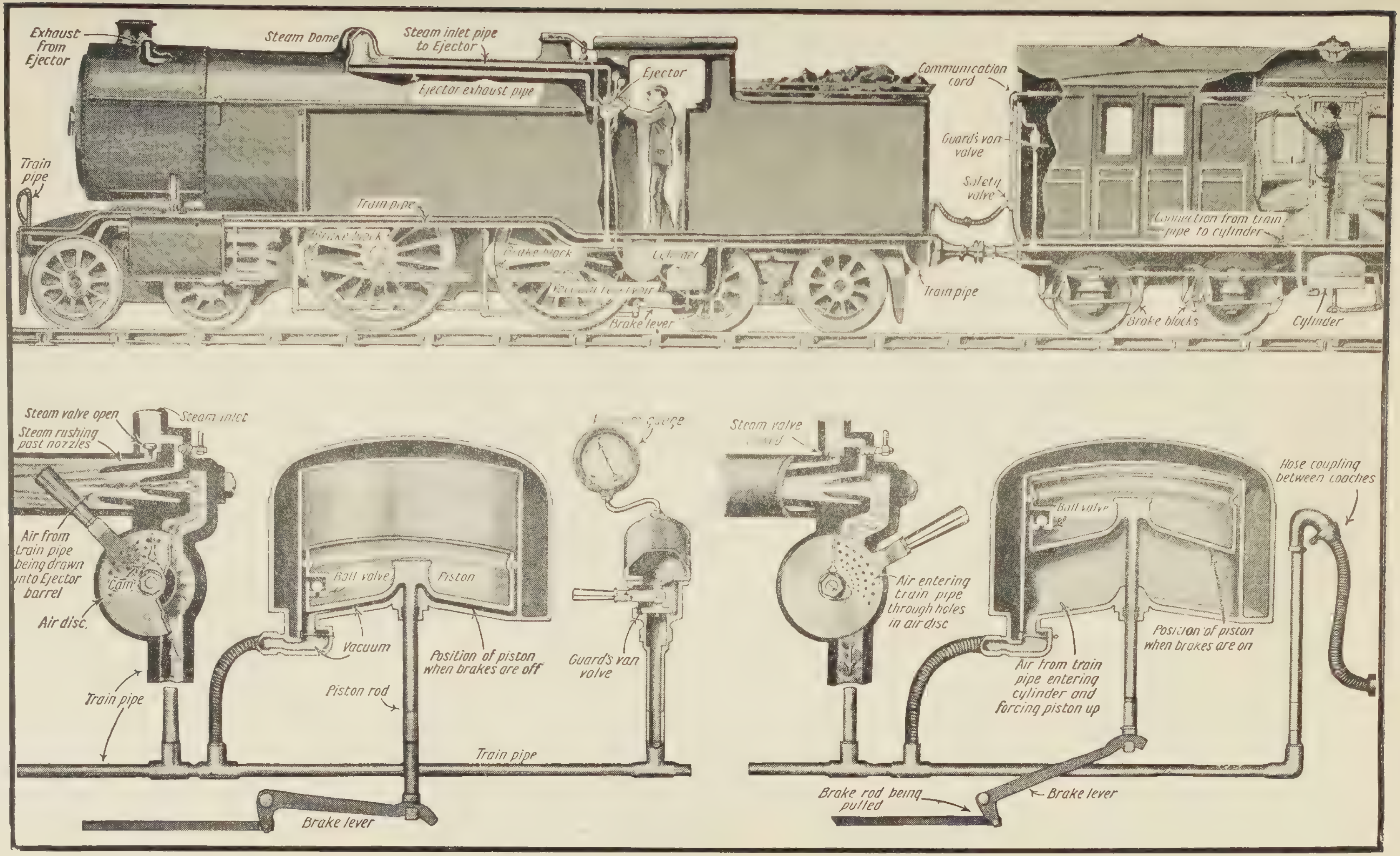
The Westinghouse brake works on the application of compressed air. This is provided on steam trains by an auxiliary engine driving a compressor. This pumps air into a main tank at a pressure of about 100 pounds per square inch, and also into other reservoirs under each coach or waggon of the train at a pressure of 70 pounds per square inch. All these reservoirs are connected by a flexible hose-pipe running the whole length of the train. The compressed air in the reservoirs under the vehicles presses against one end of a piston enclosed in a cylinder; the other end is connected through a system of levers to the brake-blocks or shoes on the rims of the wheels.

While the air pressure in the vehicle cylinders stays at 70 pounds to the square inch, the brake-shoes are held away from the wheels. To apply the brakes, the engine driver turns a handle which admits compressed air from the main reservoir. The higher-pressure air then passes through the pipe and reservoirs (raising their air pressure), and thence into the cylinders, pushing the pistons forward and applying the brakes.

To release the brakes, the original pressure is restored by closing a valve, which allows air from the main reservoir to pass through the pipe. The pressure then opens the valves in the vehicle reservoirs and empties the cylinders of the compressed air, so withdrawing the pistons and releasing the brake-shoes.

Vacuum and Magnetic Brakes

The Westinghouse brake is used on electric trains in Britain, but for other trains the British main-line railways, as well as most railways of India,



THE WORKING OF VACUUM BRAKES ON A STEAM TRAIN

Top diagram shows driver's control, guard's control, and passenger's emergency cord connexion. Below, left : brakes held "off" by atmospheric pressure above piston and lowered pressure beneath it. Right : vacuum destroyed by air entering train pipe and brake cylinder, forcing up piston and applying brakes. If the coupling between coaches should part, air similarly will rush in and bring the two portions of the train to a halt. The brakes can also be applied from any part of the train by pulling a chain.

Pakistan, Africa, and South America, use the automatic vacuum brake. This system utilises atmospheric pressure to apply the brakes. Brake cylinders are provided on each vehicle, and each brake cylinder has a vacuum chamber above the piston. The pistons are connected by levers to the brake shoes. All the vacuum cylinders are connected to one another and to the engine by a train pipe having flexible hose-pipes between vehicles. The engine end of this pipe is connected to an ejector, a device which draws the air from the train pipe and cylinders and also from the vacuum chambers. A vacuum is thus created on both sides of the piston, which falls by its own weight and pulls the brake off.

Admitting air into the train pipe by turning a handle on the engine destroys the vacuum below the pistons in the brake cylinders on the vehicles, so that there is more pressure under the pistons than on top of them. This causes them to rise; and as they rise they pull the brake levers and force the shoes against the wheel rims. Air admitted to the train pipe is prevented from entering the vacuum chambers by a small ball valve. One advantage of the vacuum brake is that if the train breaks, air rushes into the broken train pipe, the vacuum under the pistons is destroyed, and the brakes on both parts of the train are automatically applied.

In an emergency the brakes can be applied by a passenger from any part of the train by pulling a communication chain in his compartment, to open a valve and admit air to the train pipe. The guard can also apply the brake by means of a valve in the van.

Electric trams and some types of electric train are fitted with magnetic brakes. To stop, the driver cuts off the current, and the motors, driven by the forward movement of the vehicle, become dynamos (see article), which then generate a current. This magnetises a shoe which, being magnetised, is drawn down on to the rails and so stops the vehicle.

Road Vehicles

As it would be impossible to have brake-shoes pressing against rubber tyres, most brakes on mechanical road vehicles operate on the insides of drums fitted to the axles. There is a drum fixed to each wheel, and inside are two curved shoes, normally retained out of contact with the drum. The shoes are expanded by depressing the brake pedal linked to each brake by either cables or rods (or now more generally by a hydraulic system). Some sports cars and other higher-powered cars are now fitted with brakes in which a fairly thick steel disc replaces the drum, and pads of friction material are brought into contact with the disc by hydraulic pressure. (A fuller description of brakes on motor vehicles will be found under MOTOR-VEHICLE.)

Bicycle brakes are usually operated by the application of two brake-blocks upon the rims of the wheels. They are of two types: one, operated by a wire cable, is usually fitted in racing models and lighter cycles, the other, the "roller-lever" type, operated by rods throughout, is more usual in the heavier machines. The old "back pedal" or "coaster hub" type, an internal expanding brake in the rear hub operated by a backward movement of the pedals, is rarely fixed to British bicycles nowadays.

Lifts and Cranes

A "safety" brake used on lifts, to stop a lift car that descends at excessive speed, consists of safety clamps (one per guide rail) secured beneath the car. Each clamp has two steel jaws which grip the rail under the influence of a heavy flexible rail. An endless rope attached to the "safety" brake on the car passes over a governor at the top of the lift-shaft and under a "tension pulley" at the bottom. The safety system does not operate unless speed is excessive; then the governor automatically clutches the endless rope, so bringing the car to a smooth sliding stop.

Brakes on cranes and winches sometimes consist of a steel strap passing round the drum which winds in the lifting cable. Pulling on a lever tightens the strap and stops the drum from turning. The huge winding-drums, often 20 feet in diameter, used at collieries to raise and lower the cages in the pit-shaft, are braked by shoes which mechanically grip the edges of the drum.

Brass. One of the first alloys (see article) to be made by man was brass, a mixture of copper and zinc. The Old Testament tells of Tubal Cain, who was an "instructor of every artificer in brass and iron," while the ancient Greeks and Romans were expert workers in the metal.

In medieval times most of the brass produced in Europe came from Germany, and its manufacture was not introduced into Britain until 1649, when a German engineer set up a works at Esher, Surrey.

One of the great difficulties of manufacture is that zinc and copper have different melting points. Thus copper melts at 1,083° C., while zinc melts at 419° and boils at 907°. If anyone tried to make brass simply by putting pieces of copper and zinc in a crucible and heating them to more than 1,083° C., both metals would certainly melt, but the liquid zinc would boil away like a vapour in much the same manner that boiling water turns into steam. This difficulty is overcome by first heating the metal that takes longer to melt—the copper. Solid zinc is then added and dissolves before very much is boiled away.

There are three chief kinds of brass: alpha brass, which contains less than 39 per cent. of zinc; alpha-beta brass, containing between 39 and 46 p.c.; and beta brass, which contains between 47 and 50 p.c. Alpha brass is very soft (ductile) and can be worked into shapes without heating; it is used for making rivets, chains, screws, wire, and tubes. The alpha-beta kind is harder and stronger; objects made from it have to be cast or forged; it is used for rods, taps, ornaments. Beta brass, strongest of all, is used for heavy castings.

Brass is rich yellow in colour, takes a very high polish, and is extensively used for making ornaments, bowls, and trays; bowls and trays are often beaten into shape with a hammer by hand and left with the hammer marks showing. Monumental brasses, introduced in the 13th century, are plates of brass engraved with effigies and lettering, and riveted to slabs of stone as memorials to the dead. There are about 4,000 examples in English churches. (*See* BRONZE; COPPER; ZINC.)

SÃO PAULO : BRAZIL'S CITY OF SKYSCRAPERS

South America's leading industrial centre, and claiming to be the fastest-growing city in the world, São Paulo was only a shabby town in the 1870s. Many wide avenues, lined by palatial stores and huge blocks of offices or flats, have been driven through areas of narrow streets. The city's industries include food processing, textiles, and chemicals.

Brazil. Sometimes the history of a country moves so fast that facts and figures about it become out of date a few weeks or months after they are written down. So it was with South Africa when gold was found there ; so it was with the United States of America in its great period of expansion in the 19th century ; and so it was with those other united states, the United States of Brazil, in the late 1950s.

Even before considering its progress during the mid-20th century, the very description of the country is a catalogue of superlatives. Brazil is the third largest state in the world, with 14,300 miles of frontiers and over 5,600 miles of coastline ; in the Amazon (see article) it has the longest of all rivers, at the mouth of which lies an island, Marajo, bigger than Belgium ; its great waterfalls, Iguazu and Paulo Alfonso, crash down from a height exceeding that of Niagara ; in Amazonia and the coastal belts are more than 1,000 varieties of orchid—and so forth.

In the years following the Second World War the vastness of Brazil's geography was rivalled by spectacular developments in the fields of industry and commerce. Away back in 1920 the country had to import virtually all the tools and products of everyday life, even including ice ; but by 1957 it was turning out precision instruments,

Extent.—West to east, at widest, about 2,700 miles; north to south, about 2,700 miles; area 3,288,000 square miles. Estimated population (1957), 59,250,000. (1950 census, 52,645,000; 1920, 27,404,000.)

Natural Features.—Amazon Basin forest in north and west; Brazilian highlands in east. Rivers: Amazon, with its tributaries (chief, Japura, Negro, Juruá, Purus, Madeira, Tapajos, Xingu); Tocantins, with tributary Araguaya; São Francisco, Paraná, Uruguay, Paraguay.

Climate.—Tropical, with wet winters and dry summers, except in the highlands, where it is temperate, with severe drought from time to time, and great extremes of temperature.

Chief Products.—Livestock, frozen and tinned meat, hides; coffee, cotton, cacao, sugar, oranges, pinewood, beans, maté tea, carnauba wax (for electrical insulation and gramophone records); quartz, beryllium, manganese, iron, coal, gold, industrial diamonds, topazes.

Chief Cities.—Rio de Janeiro (capital, population in 1950 2,303,065); São Paulo (2,017,025 in 1950 but estimated higher than capital in 1957); Recife 512,370; Bahia (or Salvador) 389,422; Pôrto Alegre 375,049; Belo Horizonte 338,585; Belém 225,218; Santos 206,920.

radios, diesel motors, refrigerators, and a substantial part of the equipment for its 25,000 miles of railway line (1,500 miles electrified). Between 1940 and 1950 the total of big factories jumped from 49,000 to 89,000, and seven years later it was estimated at about 125,000. Steel and cement provide two more striking examples of industrial progress. Between 1938 and 1954 production of crude steel rose by 1,200 per cent. (against a rise of 175 per cent. in the United States of America in the same period); and while in the 1920s Brazil had only one cement plant, in the late 1950s she had 31, producing 2·7 million tons, a rise of 290 per cent. against the U.S.A.'s equivalent 150 per cent.

Sailors, men of business, and tourists wealthy enough to undertake long journeys have always praised the lovely, majestic, and gloriously-sited capital, Rio de Janeiro (see article); but since 1950 the pride and joy of all the 59,000,000 Brazilians has been the mushroom city of São Paulo, capital of the state of that name, the greatest in the land, with its municipal library 15 storeys high, its superbly endowed art gallery, and a market in which every stall is fitted with a telephone. In 1949 São Paulo had only three skyscrapers: in 1956 there were 47, building or completed, in a city where it was said that "a new building is laid down every 18 minutes." By this time, too, aircraft were flying 40 daily return flights to Rio. The presidential régime of Joscelino Kubitschek, beginning at that date, announced an ambitious plan concerned with electricity, atomic energy, coal, petrol, afforestation, transport, merchant shipping, aviation, farming, steel, aluminium, and much else.

Brazil was discovered in 1500 by a companion of Columbus, a Spanish explorer called Martín Alonso Pinzón. He was followed in the same year by Pedro Alvares Cabral, who took possession of the country in the name of the crown of Portugal. But the Portuguese were at that time too much concerned with the rich finds in the East to realize what treasure might lie in Brazil. Slowly the population of the newly-imported slaves and of Portuguese settlers rose to 70,000 by 1650. Thenceforward intermarriage and more vigorous immigration swelled the total to 750,000 "civilized" Brazilians by 1700. Inside the next century the population numbered about 2,500,000, with 1,500,000 Negroes, 600,000 Indians, and 400,000 whites. At that time the rush was for the gold in the interior. Diamonds were found, and are still worked two-and-a-half centuries later.

In 1808 Brazil had become independent. But her golden era began in 1840, under the emperor Pedro II, who fostered education, developed transport and agriculture, and suppressed the

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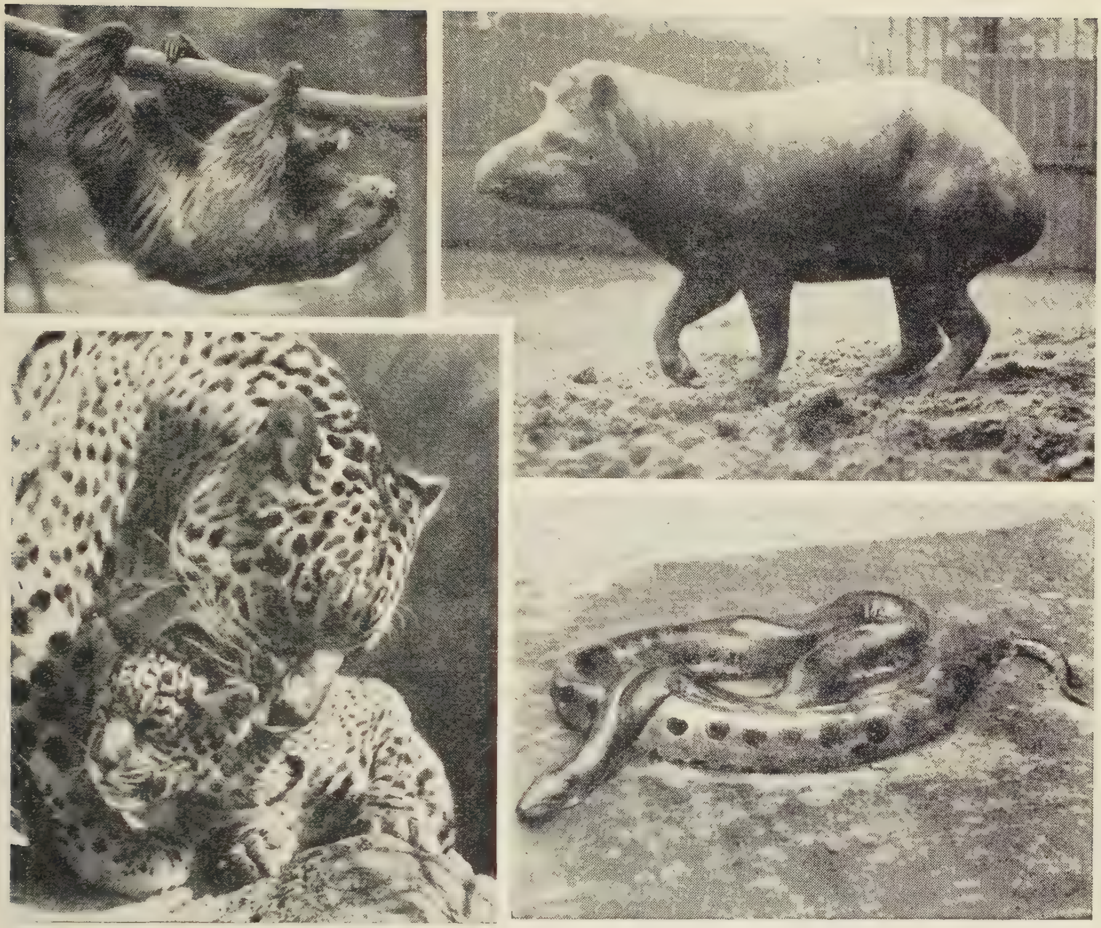
FISHING-BOATS IN THE PORT OF BELÉM

The principal port of the lower Amazon, Belém (or Pará) is situated 90 miles from the open sea, and slightly to the south of the equator. Here are ships of the fishing-fleet, with their distinctive prows, taking ice aboard so as to keep the catch fresh.



BEASTS THAT DWELL IN THE BRAZILIAN FORESTS

The two-toed sloth (top left) lives in trees, hanging from branches upside down. The tapir (top right), a timid, inoffensive animal, is brown in colour, with a crest like a hogged mane. The jaguar (bottom left) is the biggest of the American spotted cats, the head and body measuring 4 feet in length. The anaconda (bottom right) is the largest snake in the New World, sometimes reaching a length of 30 feet—over twice that of the boa constrictor.

corruption that was then the curse of the country. His policy brought in a million German immigrants and about 250,000 sturdy, sober Japanese. Yet in 1888, when he decided, at great personal cost, to abolish slavery, his rule was abruptly ended. Owners of plantations received no compensation, were ruined, and turned against him. In 1889 he was banished to Europe after a reign of 58 years, and he died in a modest hotel in Paris two years later, having proudly refused a pension from the revolutionaries.

Thereafter, as a republic, Brazil progressed slowly. In 1930 came dramatic changes with the rise to power of Petulio Vargas, governor of the state of Rio Grande do Sul, who deposed the president. Vargas held dictatorial authority till he was forced to resign in 1945. But he was re-elected in 1950, and governed the country for five years. In 1955 the governor of the state of Minas Gerais, Joscelino Kubitschek, succeeded him.

In 1957 planning began for a new capital city, Brasilia, in the state of Gorás. By 1960 work on the site was in active progress.

Brazil is now governed by a constitution based on the model of the United States of America. The chamber of deputies is elected by universal suffrage, open to all citizens over 18 who can read and write. The federal senate consists of three representatives from each of the republic's 20 states and the federal district, elected for eight years by direct suffrage. The President, who serves a term of five years, cannot be chosen for a second term immediately after the first.

The estimated population in 1957 was 59,250,000. Compare this with the 7,000,000 of a century ago. But the birth-rate, at 40 to 44 per 1,000 inhabitants, one of the highest in the world, suggests the likelihood of a vast rise before 1970. The death-rate is less than half the birth-rate, but nearly half of Brazil's inhabitants are under 15. The density of population varies from 1·4 per square mile in the northern regions to 5,815 in the federal district of Rio de Janeiro and an average for the country of 16·1 It is important to remember that since 1821 only about five million immigrants have entered the country. Thus the rise in numbers has been due to natural causes, not to any sudden inflow.

BRAZIL, LARGEST STATE OF SOUTH AMERICA

One of Brazil's most noticeable natural features is its amazing network of mighty rivers. The Amazon collects its waters from hundreds of tributaries rising in the vast sweep of mountains and hills which almost encircles it, and flows through the forested territory of northern Brazil to the Atlantic Ocean. The greater part of the interior is little known, and the bulk of the population lives either along a narrow coastal strip or on the banks of the Amazon.

More than half of Brazil lies between 650 and 3,000 feet above sea level. The north-east coast has always been the region of sugar-cane growing. From Bahia to Rio the soil is more suitable for cocoa. Enormous coffee plantations, sometimes from 100,000 to 200,000 acres in extent, stretch down to São Paulo. In the extreme south the natural scenery is mostly jungle and forest—dense, impenetrable, unexplored. Discoveries of iron ore and manganese around Amapa, and the probability that oil may be found there, have drawn special attention to Amazonia. This is the region where the 16th-century pioneers sought the fabled El Dorado (" the golden one "), and where, many explorers have died in the search for hidden gold, diamonds, and emeralds.

In this hot, humid, savage area, vegetation is more luxuriant than is to be found anywhere else on the earth. Giant trees rise from impenetrable thickets; their branches are entwined and festooned with giant lianas (creeping plants) and vines that climb to the tops of the trees, often killing them by shutting them off from air and light. Innumerable bright-plumaged birds of many species fill the forest with their harsh cries. Alligators, boa constrictors (including the huge anaconda), and numerous species of venomous snakes infest it; and it is the home of spiders large enough to prey on birds; of brilliantly-coloured butterflies; of pumas and jaguars, and such beasts as the armadillo, the sloth, the peccary (or wild pig), the tapir, and the anteater.

COFFEE, BRAZIL'S MOST IMPORTANT CROP

The state of São Paulo, in south-east Brazil, grows more coffee than any other state in the country. After the coffee berries have been harvested, they are spread out to dry on a cement floor. Besides providing one of the world's popular beverages, the ground beans are also widely used in the manufacture of plastic materials.

schools, and 17 universities. Yet in this land of the greatest imaginable variety of wild life, at least half of the people over the age of 10 still cannot read or write, not counting the inhabitants of the jungle. Most of the people are Roman Catholics. The link between Church and state was abolished in 1889, restored in 1894, and ended again in 1946. The language is Portuguese, but German and Italian are widely spoken, and English and French often written.

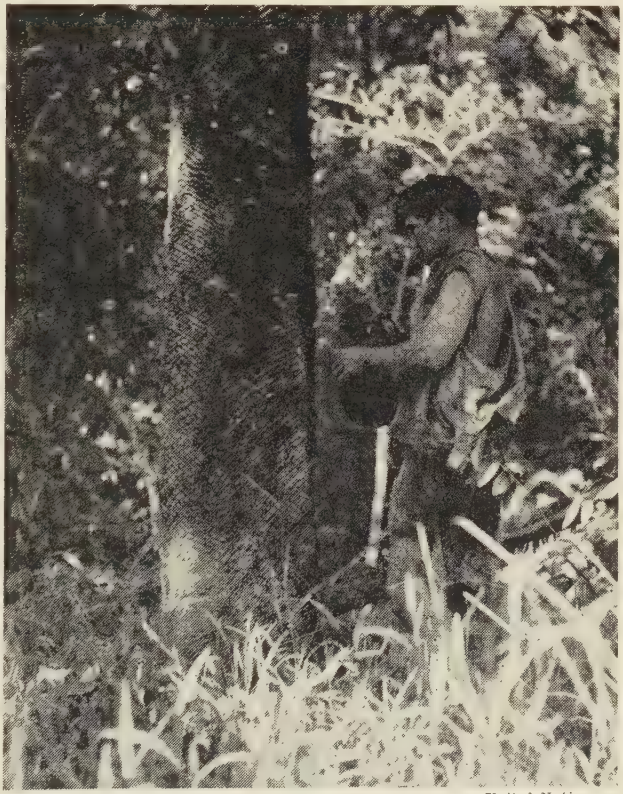
Brazil declared war on Germany in the First World War, and on Germany and Italy in the Second, sending an expeditionary force to join the Allies in Italy, and using its navy to fight German submarines in the South Atlantic.

Stock-raising is a main activity in the north-western plateau, where, as an added asset, abundant quantities of gold, diamonds, quartz, and nickel are found. In the " backbone " of Brazil, from the north of Bahia to the heart of Minas Gerais, lies the principal mining region, producing iron, manganese, gold, and diamonds. Hopes for hydro-electrical development in the Paraná basin in the south, near Argentina and Paraguay, are based on urgent research. In Brazil's forests, which cover 1,350,000 square miles (roughly 14 times the area of the United Kingdom), nature has been bountiful, providing endless varieties of commodities free. There is an abundance of timber for construction and for fuel. There is rubber, oil, and the all-important carnauba palm. Carnauba wax is used in the making of gramophone records, films, paints, explosives, varnishes, and a hundred other articles. Progress in the development of all this wealth is symbolised by the fact that whereas in 1914 Brazil *imported* 150,000 tons of whitewood, in 1953 she was able to *export* 650,000 tons.

Brazil's chief exports are coffee, raw cotton, cocoa, sugar, pinewood, iron ore, *yerba maté* (the native tea, a great favourite in Argentina and Paraguay), and Brazil nuts.

Erosion is one of the serious problems for the scientists. In one state alone, São Paulo, 74,000 acres were sterilised in one year—though where coffee is planted, the rich earth is two to three yards deep.

Education is free. In several states it is compulsory. There are over 85,500 primary schools and nearly 2,500 secondary schools, as well as technical and other " higher "



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GATHERING LATEX FROM A RUBBER TREE

The Amazon basin covers a third of Brazil, and the government is planning the scientific exploitation of the forests covering this region. Hardwood and rubber trees abound, but lack of communications, except by water, hinders commercial development.

The STORY *of a* LOAF OF BREAD

Bread and Baking. Bread is by far the most widely eaten food in the Western world, and in the United Kingdom it is estimated that one person consumes the equivalent of a 280-lb. sack of flour every year. It takes five bushels of grain to make this sack, and 100 lb. of flour to make 130–135 lb. of bread. An acre of ground yields on the average less than 20 bushels of wheat, so it is not hard to calculate the immense acreage required to supply one small country alone.

The importance of bread has been recognized since very early times. The Romans had public bakehouses, supervised by officials, and in England there have been laws governing bread for many centuries. The Assize of Bread in 1266 made rules relating to weight and quality. Present-day laws govern the weight of the loaf, the flour and other materials used to make it, and bakery conditions.

That a primitive kind of bread was made as long ago as the Stone Age is shown by the small and hard burned "cakes" that have been found in the cave-dwellings of that period, together with crude implements for crushing the grain. Apparently these early people did not grind their grain (usually wheat) into flour, but slightly crushed it and mixed it with water. The mixture was then placed on a hot stone and hot ashes were piled on top. The result was a hard cake, gritty from the ashes, and very unlike the leavened bread of to-day.

Leavened bread is "raised" bread, prepared with yeast (see article) or some other substance which makes the loaf light and porous. Unleavened bread is dry and hard throughout—perhaps the best known example is the *matzos* eaten by the Jews at Passover. It is not certainly known who first made leavened bread, but it is probable that the ancient Egyptians did so by using a small portion of the uncooked dough left over from the previous day's baking. This dough goes sour; mixed with the fresh dough, it causes it to ferment, and in this way gas is formed and the bread is raised or leavened. This method is still used in districts where it is not possible to obtain yeast. In England brewer's yeast has been used for some 500 years, but in countries such as France, where far more wine than beer is drunk, sour dough was in general use for a long time.

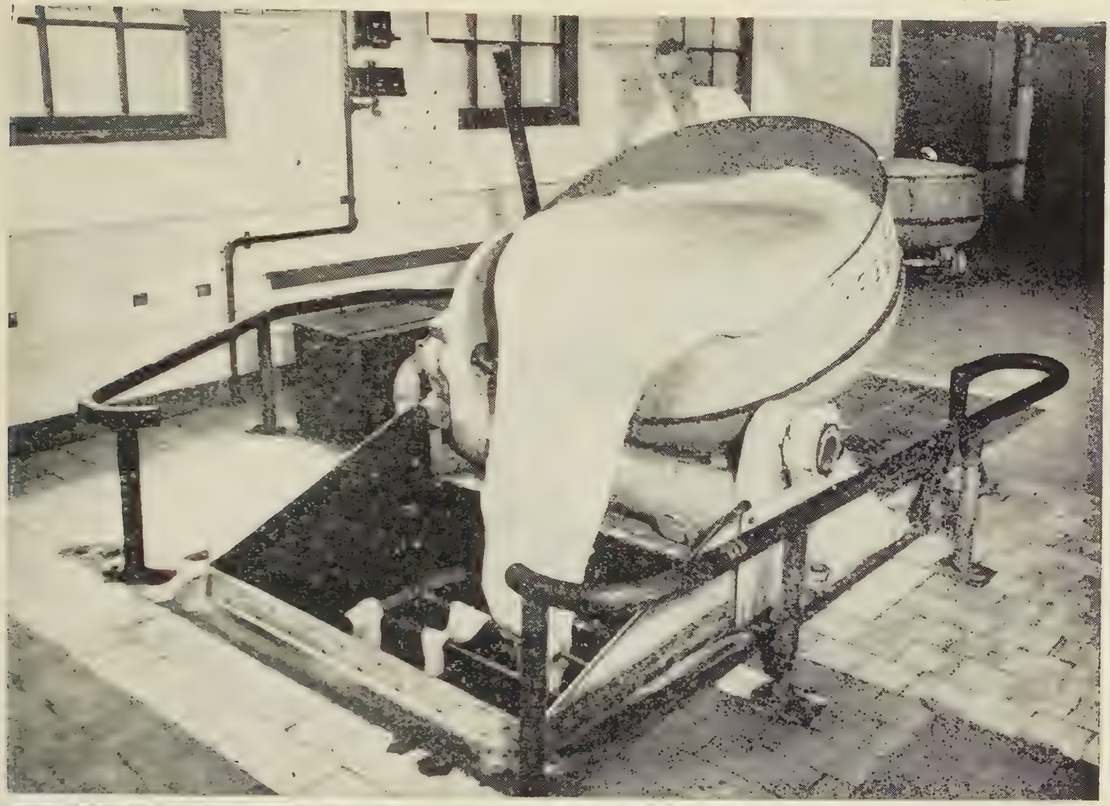
Most of the world's bread is made from either wheat or rye flour, although barley, maize, oats, rice, and potato flour are also used, singly or in various mixtures. Rye bread is much eaten in Scandinavia and other parts of Europe.

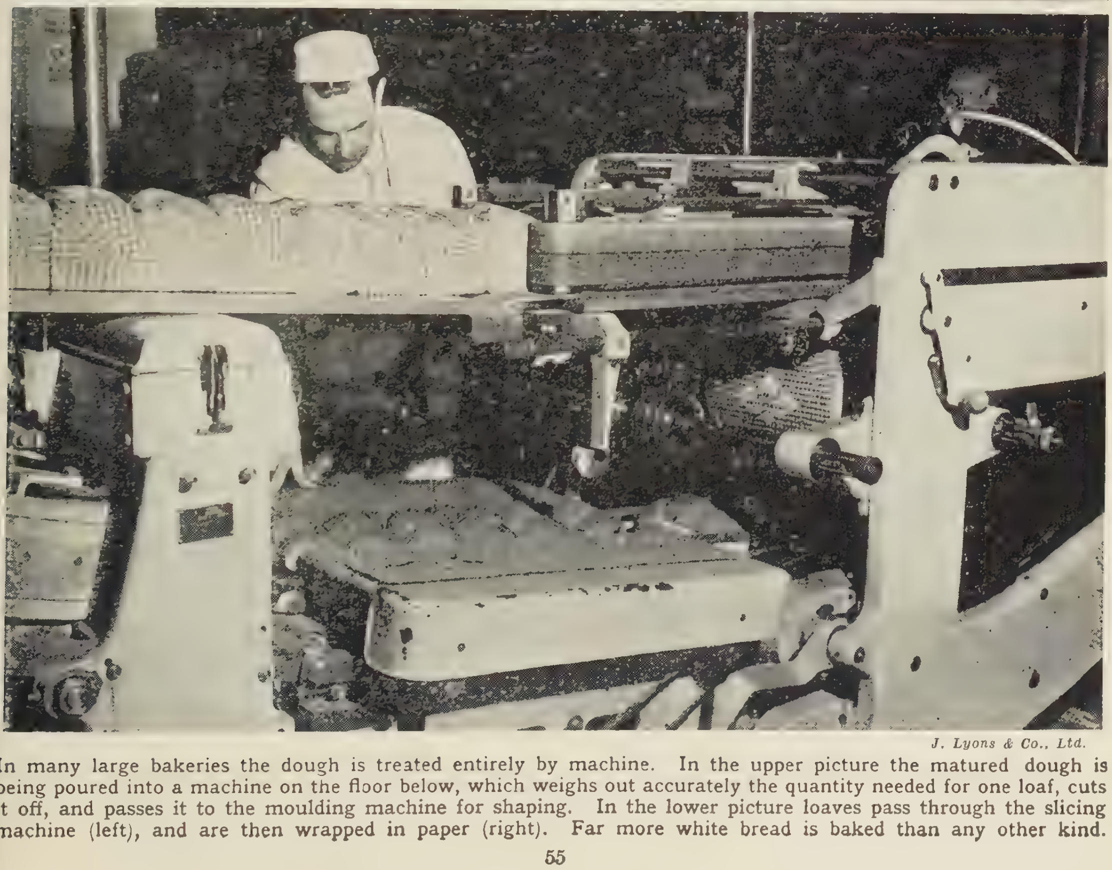
In Great Britain nearly all bread is now made from wheat, but in medieval England a dark,

"WHOLESALE" BAKERY OF ANTIQUITY

These reliefs from the tomb of an Etruscan chief illustrate the story of bread-making in ancient Rome, where the methods of Etruscan bakers had been adopted. In the middle row, donkeys are grinding grain; in the bottom row, dough is being mixed on tables before the uncooked loaves are placed in the beehive-like oven. At the top, loaves are delivered to the shop, where they are weighed and sold to the customers, seen standing in line on the right.

BREAD IN THE MAKING, UNTOUCHED BY HAND

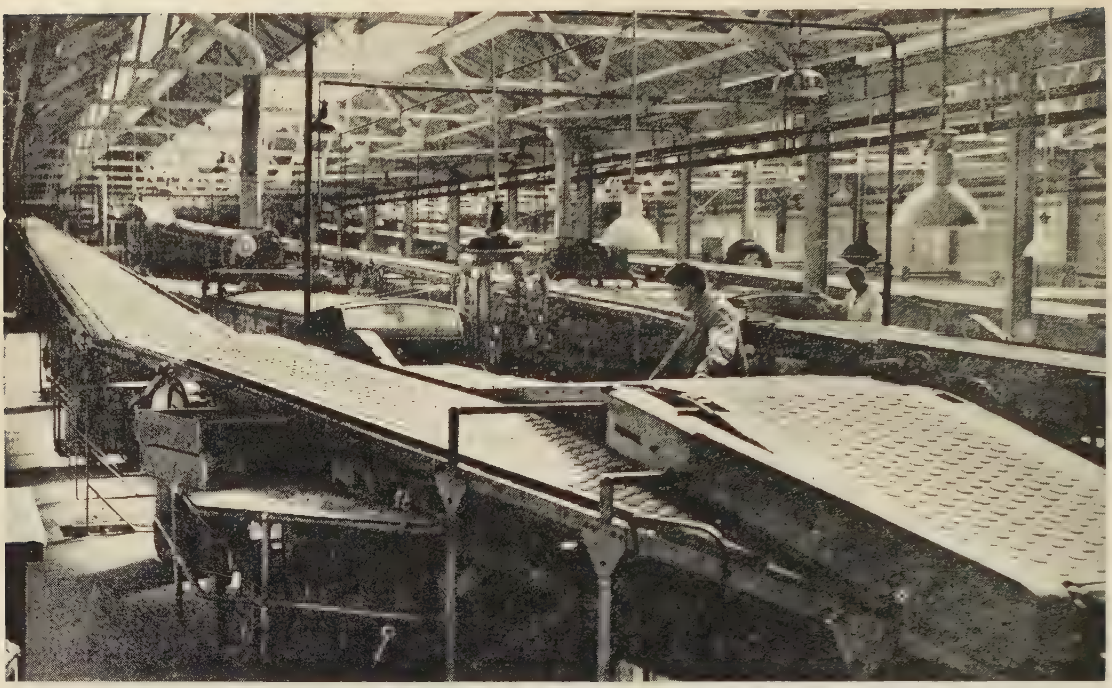




J. Lyons & Co., Ltd.

In many large bakeries the dough is treated entirely by machine. In the upper picture the matured dough is being poured into a machine on the floor below, which weighs out accurately the quantity needed for one loaf, cuts it off, and passes it to the moulding machine for shaping. In the lower picture loaves pass through the slicing machine (left), and are then wrapped in paper (right). Far more white bread is baked than any other kind.

BISCUITS ON THEIR WAY TO THE SHOPS



Huntley & Palmer, Ltd.

The principal difference between biscuit and bread is that biscuit contains less moisture ; is a more concentrated food ; and will keep longer than bread. After the ingredients have been mixed by machinery, they are rolled to the required thickness and travel on a conveyor under the cutter. The shapes then pass through an oven, emerging perfectly baked (top picture) and ready for packing in tins. The labels are pasted on the tins by hand (lower).

so-called black, loaf made from rye flour was the principal bread. A loaf similar in appearance was also made from barley ; and there were mixtures of wheat and rye (maslin), and of rye and barley. Usually the bread was baked at home, but sometimes the lord of the manor compelled tenants to bring their dough to his oven and pay for its use.

By about the middle of the 19th century wheat had almost entirely replaced the other grains as the chief source of flour for bread-making. For over a hundred years there had been a growing demand for white wheaten bread. White bread can be made from wheat flour, provided that the bran, the outer layers of the grain, is sifted from it. This was an expensive and wasteful business until modern milling machinery was invented (*see* FLOUR). Consequently white bread was originally used only by the wealthy, but the demand spread, not only because the white wheaten loaf was more attractive and pleasant to the taste than the coarse, dark " whole meal" bread of earlier times, but because many people were anxious to imitate the eating habits of the upper classes. The change did not come about because white bread made from wheat is more nutritious.

Because white flour was expensive, unscrupulous millers added harmful substances, such as alum, in order to produce a white loaf. This abominable practice was not really scotched until 1872, when effective laws were passed to prevent it. White bread from pure flour and without any harmful added substances became the usual bread for the great majority of English people.

The " Extraction Rate "

But this really white flour contained only about 70 per cent. of the wheat grain—the dark parts of the grain (the bran, etc.) were mechanically sifted and used for feeding animals and for other purposes. This is called " 70 per cent. extraction rate " flour, because only that amount is extracted by the milling machinery. During the two World Wars the United Kingdom was not able to get as much wheat as it required, so the " extraction rate " was raised, in the Second World War to as much as 85 per cent., thus making the loaf darker.

It was not only a shortage of wheat that caused the rate to be raised, but the desire to use valuable nutrients, particularly vitamin B1, which are in the darker part of the grain. By using new methods of milling it was possible both to economise on grain and to keep the valuable nutrients, and at the same time produce a loaf which tasted good, kept well, and had a good white appearance. High extraction rate flour continued to be used after the wars.

There are many different kinds of bread. The " tin " loaf is the most familiar in England, though there are many other shapes, as well as a great variety of brown bread, made from very high extraction rate flour. Scotland has its own " batch " bread, a tall loaf with white sides and thick crust at the bottom. In France there is the baton loaf, about four inches in diameter and often nearly a yard long. Vienna bread, with its crisp crust and open texture, is popular in a number of countries. Less well known is the soda bread made in some parts of Ireland, with sour milk and baking powder instead of yeast. Pumpernickel is a German bread made from rye flour.

Few English people now bake their own bread. More and more of it comes from large machine bakeries ; and, as with other factory operations, new machines are continually being devised to reduce the amount of human labour required. There is even a " sleeping baker," the controls of which can be set so that it will mix dough at any time of the day or night, thus doing away with much of the night work that has always been a feature of the baker's life.

The big machine bakeries also make rolls, scones, crumpets, cakes, and all the other things you can see in a baker's window. Baking has indeed become a highly scientific business, and two organizations, the Cereals Research Station of the Association of British Flour-Millers and the British Baking Industries Research Association, are constantly engaged on problems connected with improving the quality of flour, bread, biscuits, and cakes.

Machine baking does not differ in principle from home baking. Flour, water, and small quantities of salt and yeast are kneaded into a dough which has a temperature of about 80° Fahrenheit. It is at this stage that the quality of the gluten in the flour becomes noticeable. Gluten is the coating on wheat which contains the protein glutenin, and, making the dough springy and elastic, provides the framework of the loaf. In large bakeries, doughs are regularly tested to ensure that the gluten content is correct. The next stage is to allow the dough to rest for between three and four hours, while fermentation makes the dough rise. It is then cut up into pieces of the required size and weight. These are shaped, rested for between 10 and 20 minutes, and then moulded into their final shapes. After a further period of fermentation—40 to 60 minutes—the dough is baked for about 45 minutes at a temperature of between 450° and 500° F.

A really good loaf has an even shape. The crust should be golden brown, firm, and not bursting open. The crumb, or inside of the loaf, should be soft, silky to the touch, and not crumbling.

Biscuits are made from a much stiffer dough, which contains less moisture. The dough, which is unleavened, is pressed and cut into shape mechanically. The shapes are then passed on an endless steel belt through the oven, and emerge ready for packing. For the fancy varieties of biscuit the process is more complicated. There are now many hundred types of biscuit ; several different kinds of flour are used to make them, and also sugar, fats, spice, butter, milk, and eggs. Biscuits, unlike bread, are comparatively new. The earliest kind was the ship's biscuit, or cabin bread, which was used as a substitute for bread at sea. Dr. Oliver, a famous Bath physician, introduced the dry biscuit still called the " Bath Oliver " in 1735 ; but few of the varieties sold to-day have been manufactured for more than a century.

Bread-fruit. An important food of the South Pacific islands is the large globular bread-fruit, and the famous expedition of H.M.S. *Bounty* (see article) was for the purpose of collecting bread-fruit trees for planting in the West Indies. On various species of the tree the fruit ripens at different periods of the year, thus affording an almost constant supply.

The tree belongs to the genus *Artocarpus*, and to

BREAD-FRUIT ON THE BOUGH

Baked whole, or made into flour, the large fruit of the bread-fruit tree is an important food wherever it occurs. Canoes and furniture are made from the wood, glue from the juice, and cloth from the inner bark.

the mulberry family. It grows to a height of 40 to 60 feet, and is often limbless for half that height, with large spreading upper branches. The deeply divided leaves are up to 18 inches long. The starchy fruit, hanging from short thick stems, is about the size of a human head, and it weighs 3 or 4 lb. It is first green, then brown, and when ripe turns yellow. Although the young fruit produces a thick, milky fluid, which is nourishing and pleasant to the taste, it is not generally used for food until it has matured.

The bread-fruit is prepared for use in a number of ways. The natives usually gather it just before it is ripe and bake it whole in hot embers. They then scoop out the inside, which when properly cooked is soft and smooth, with a faint taste not unlike boiled potatoes and sweet milk. Another method is to cut it into thin slices which are dried in the sun and then baked or made into a flour.

From the fibrous inner bark of the tree a cloth is made, and from the wood canoes are built and furniture is manufactured. The sticky milky juice obtained from cuts in the stem is used in making a kind of glue and for waterproofing canoes.

Breakwater. In some places, such as London, Sydney, and Cork, nature has provided landlocked harbours where ships are safe from violent waves caused by storms (*see* HARBOUR). Often, however, a harbour must be built for commercial reasons in a spot that is open to the sea. Then some structure must be provided which will break down the violence of the waves; otherwise the ships might be hurled ashore or smashed. These structures are called breakwaters.

The force exerted by waves in a big storm is terrific. Big ships can be thrown bodily on to dry land and enormous blocks of stone shifted hundreds of feet. A block weighing ten tons has been thrown on to a cliff 20 feet above normal water level. This violence makes the building of breakwaters one of the most hazardous of engineering works; and often one has been destroyed during construction. It has been found several times that the greater the distance the waves travel before they strike land—a distance known as the "fetch"—the higher are the waves, and therefore the greater is their destructive force. Thus the waves on the English Channel coast are never as violent as those on the Atlantic coast.

If you watch waves during a storm advancing over a gently sloping beach, you will see that they break far out and only a small wave reaches the shore. If, however, the waves travel over deep water to a cliff, they strike it with great violence and often tear out bits. Nowadays, breakwaters are designed to make the waves break far out. Stones of the biggest available size are deposited on the sea-bottom and built up to form a great bank. The bank has a broad, level top above sea-level, and the sides slope outwards very gently. The surface is paved with large stones, carefully cut, and fitted together by divers. The waves break far out on the seaward slope and lose most of their violence. The magnitude of these works can be seen from the breakwaters at Portland —100 feet high, 300 feet thick at the bottom, and 8,000 feet long; at Plymouth—300 feet at base and 45 feet at the top; and Cherbourg—298 feet at base, 21 feet at the top, and 12,000 feet long.

Formerly the difficulty was to get rocks so large and heavy that the waves could not move them. Now blocks of any size and shape can be cast in concrete, and 40-ton blocks were used in the construction of Dover breakwater.

When the Allies invaded France in 1944, they towed with them across the Channel structures to make two artificial harbours. Before the harbours were assembled off the French coast, ships were filled with concrete and sunk to form breakwaters, which enclosed the harbours in an area of comparatively calm water. Without these the harbours would have been useless. (*See* MULBERRY HARBOURS.)

Bream. These fish are always found in shoals, and if you watch them in a still, deep pool, you will see that they appear to be under the control of one of their number, and swim about on the principle of follow-my-leader.

The bream is a peculiar-looking fish, having great depth of body, so that it is thin and flat-sided. Its back is a dark brassy colour, and its fins blue-black. Bream are found in the rivers, lakes, and sluggish streams of Europe and Northern Asia. The only British species are the common (*Abramis brama*) and the white (or silver) bream (*Abramis blicca*). The Norfolk Broads contain bream in great numbers.

Bream can be eaten so long as they are boned and cooked very soon after being caught; but catching them is by no means easy, and even when they are hooked the fisherman has a very messy job in hand, for the bream is the slimiest fish imaginable. In fact, bream make such a mess of a boat that fishermen usually keep those they

have caught in a net over the side. Bream from 1 lb. to 3 lb. in weight are not uncommon.

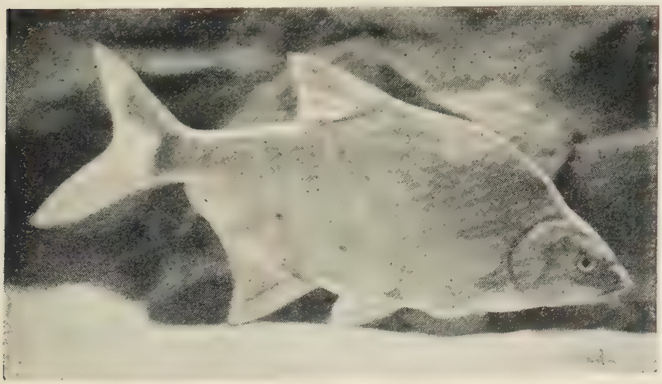
There are several sea bream, members of the family *Sparidae*, and unrelated to the fresh-water bream. Of these the common sea bream (*Pagellus centrodontus*) and the black sea-bream (*Cantharus lineatus*) are often found off the southern shores of Britain. Others are rare in British waters.

Breathing. *See* LUNGS ; RESPIRATION.

Breconshire, WALES. Breconshire (or Brecknockshire) has some of the most beautiful scenery of South Wales, with fertile valleys lying between the *esgeiriau* (rolling moorland ridges) of the north and the mighty mountains of the south. The Welsh name of this county is Sir Frycheiniog. (*See* WALES : map).

In the extreme north is the highest part of the Elenith Hills, a large area of roadless moorland (Drygarn Fawr, 2,115 feet). To the west the Towy divides Breconshire from Cardiganshire. Between the Elenith Hills and the flat-topped Mynydd Epynt range (Drum Ddu, 1,554 feet) is the Irfon valley with three small spas, Llanwrtyd Wells, Llangammarch Wells, and Builth Wells. The British Legion's Cambrian hand-loom weaving factory is at Llanwrtyd Wells. Near Builth the last Welsh Prince of Wales, Llewelyn ap Gruffydd, was killed in 1282. At Builth Wells the Irfon flows into the Wye, which divides Breconshire from Radnorshire. In the Usk valley to the south of Mynydd Epynt is the county town of Brecon (or Brecknock —population in 1951, 6,466). Here Mrs. Siddons, the great actress, was born in 1755. The Priory church is one of the finest in Wales. The Wye and Usk valleys are very fertile and have fine scenery. Crickhowell stands on the Usk, to the east, and Hay is cut into two by the Brecon-Hereford border.

A magnificent range of mountains from the Brecon Beacons to Carmarthen Van (just in Carmarthenshire) runs across the south of the county. It is called variously Fforest Fawr or the Fans and Beacons Range. Pen y Fan, or Arthur's Chair (2,907 feet), one of the Brecon Beacons, is the highest mountain in South Wales. The extreme south of the county is in the South Wales coalfield, Brynmawr being the chief mining town. The highest part of the Black Mountains (Waun Fach, 2,660 feet) is in the extreme east of Breconshire.



BREAM OF THE FRESH WATER

A notable characteristic of the bream is great depth of body. There are two British species, and weight ranges up to about 3 lb. They can be eaten if boned and cooked soon after being hooked.

The chief industry of the county is agriculture, although owing to the mountains there is not much fertile soil. Towards the Herefordshire border there is fruit growing. Iron, copper, lead, and limestone are worked in the south of the county. The area of the county is 734 square miles and the population in 1951 was 56,484. Less than half the population speak Welsh.

Bremen, GERMANY (pron. brā′men). In the Middle Ages there were over a hundred free cities in Germany, but throughout the centuries the number was reduced, especially in 1806 when Napoleon ended the Holy Roman Empire. In 1871, when the new German Empire was founded, only three remained—Hamburg, Lübeck, and Bremen. Bremen then became a state of the German federation. This exceptional position was retained until after the Nazis came to power, when the constitution of Bremen was abolished and after 1933 the Free State was under the rule of a *Gauleiter* (district governor).

First mentioned in the time of Charlemagne, Bremen became the seat of an archbishop in 848, and from then onwards it was an important missionary centre for Germany and Scandinavia. It joined the Hanseatic League (see article) in the year 1260.

Bremen is situated on both banks of the Weser, about 46 miles from its mouth. On the left bank is the new section, composed chiefly of wide streets. The city had many old buildings of great architectural interest, including the magnificent 15th-century town hall (badly damaged during the Second World War) and the Merchants' Hall, side by side with the cotton exchange and other modern buildings.

Smaller vessels can come up to the docks in Bremen, but most of the large ocean-going steamships dock at the city's port, Bremerhaven, which is only 10 miles from the open sea. A new lock and an inner harbour for vessels up to 70,000 tons were opened in 1931.

A centre of German shipbuilding, Bremen and its port suffered severely from Allied bombing attacks and the fighting of April 1945, during the Second World War. But much rebuilding has since taken place. During the military occupation of Germany that followed the end of the war Bremen and Bremerhaven formed an isolated piece of the American zone in the British-occupied zone of Germany, otherwise the American zone would have had no port of its own. In 1947 this district was made into a separate *Land* (state), 156 square miles in area, which became one of the *Länder* of the Federal Republic of West Germany in 1949. The population of the city in 1951 was 456,528 ; that of the *Land* including the city was 572,587.

Brest, FRANCE. The seaport of Brest lies near the tip of the rugged coast of Brittany, in north-western France. It is an important French naval station, and ships enter Brest Roads, the wide rock-bound harbour, through a narrow strait guarded by a formidable system of modern forts. It is the finest natural harbour in Europe, about 14 miles long and seven miles wide. The town is

built on the steep slopes of two hills, separated by the river Penfeld. An imposing 12th-century castle and massive tower, much rebuilt in the 17th century, stand above the river. Important sardine and mackerel fisheries have their headquarters at the port, and flour mills, chemical plants, engineering works, breweries, and other industries employ large numbers of hands.

For over 50 years in the 14th century Brest belonged to England. In the 16th and 17th centuries it was attacked unsuccessfully several times by the English. Richelieu made it a naval station. It was the port for American troops landing in France in the First World War, and was one of the British supply bases in the first year of the Second World War. Captured by the Germans in June 1940, it sheltered the German battleships *Scharnhorst* and *Gneisenau* in 1941 and 1942, when they were repeatedly bombed by the R.A.F. When the Allies drove the Germans from France in 1944, an isolated garrison held out at Brest for over a month. The town was badly damaged, but reconstruction was soon begun. Then, in 1947, about two-thirds of the town suffered further serious damage when a Norwegian nitrate ship blew up in the harbour. The population in 1954 was 110,713.

Briand, ARISTIDE (1862–1932). In the 1920s, while war-scarred Europe tried to struggle back to peace and prosperity, a French statesman worked on an idea which might have changed the whole course of world history. Aristide Briand had served his country often and well as premier and foreign minister; but he saw that progress lay not in winning wars, but in preventing them. French nationalists attacked him for not being stern enough with Germany over reparations fixed by the Treaty of Versailles, and in 1922 he resigned from office. But he went on working in the background, and with his former enemy, Stresemann, and Austen Chamberlain from Britain, worked out a plan for settling disputes by peaceful international discussion. His plan came to life in 1925 with the signing of the Treaty of Locarno, and in 1926 Briand and Stresemann shared the Nobel peace prize for their achievement.

As foreign minister in 1926 he was co-author of the Kellogg-Briand Peace Pact—another step towards his greatest ambition, to see a United States of Europe bound together by the need for trade and prosperity. By 1930 this idea had been accepted in principle by European governments; but the League of Nations was too much occupied with disarmament disputes and the world's economic crisis to discuss putting it into practice, and two years later Briand died.

This imaginative and intensely practical lawyer from Brittany entered politics as a Socialist and finished as leader of the cultured, moderate middle classes. Once he broke a nation-wide railway strike in France by calling up the railwaymen as reservists and putting them on duty on the railways. He was a fine orator, and a sincere, generous man, who always put people in general before parties or nations, and his only enemies were those who were afraid of changing their minds.

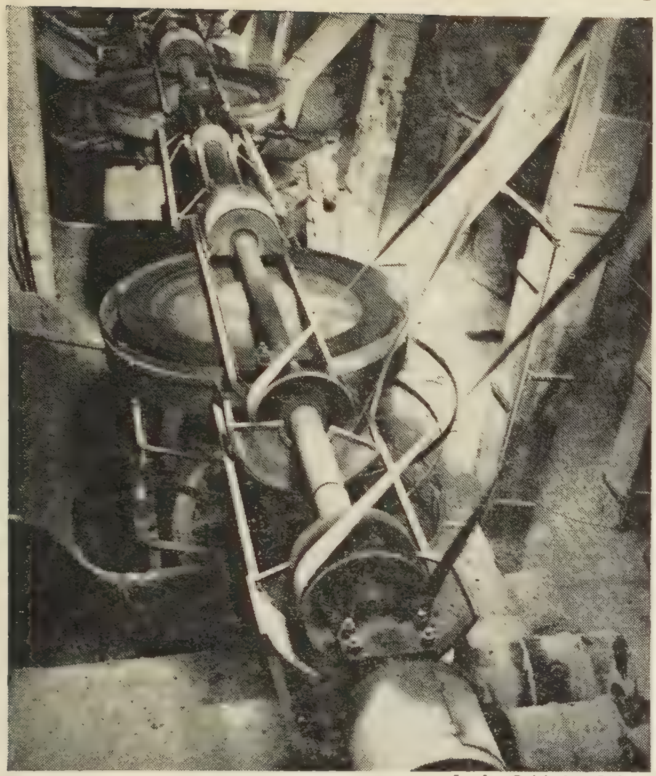
RAW MATERIAL *of the* HOUSE

Bricks and Tiles. The early civilizations which grew up in the valleys of the Nile, Tigris, and Euphrates were the inventors of brickmaking. Hitherto men had been content to cut timber, and later stone, to make the walls of their houses; but in these great valleys the most abundant material was the soil brought down by the rivers, and the inhabitants learned how to use it. Their method is still in wide use in the Middle East.

In this primitive technique of brickmaking the soil is mixed to a thick paste with water, and then chopped straw is added to give it cohesion. (This explains the Israelites' complaint when they were asked to make bricks without straw.) The mixture is then filled into wooden moulds and dried in the sun. These sun-dried bricks are weak, and easily destroyed by rain and storm, but they were used in all the great prehistoric cities of Mesopotamia.

Nowadays (except for temporary buildings in the tropics) all bricks are "burned" or "fired" at a high temperature. The art of making "burnt" bricks was discovered over 3,000 years ago by the Babylonians, long before Nebuchadnezzar; and some of their imposing buildings still survive. The Saracens carried on their tradition; and the Romans seem to have been the first to use the same method in Europe. The Roman methods were described by Vitruvius, a military engineer, in a book written in 16 B.C.; and some of their work can still be seen in London and at St. Albans. After the Romans left Britain in the 5th century A.D., brickmaking was not resumed there till Tudor days. Many beautiful Tudor brick buildings remain, such as Hampton Court Palace and St. James's Palace, London; and after the Great Fire of London (1666) the City was rebuilt in brick. All these early craftsmen made good bricks; and the process of "firing" is still fundamentally the same.

To get the best brick of the best colour, it is important to know the composition of the "brick earth," which is essentially clay or a mixture of clay and other materials. Different localities produce different varieties, each with its own qualities. London clay warps when burned unless it is mixed with ashes, sand, or some other similar material. The clay found at Fletton, near Peterborough, contains so much combustible matter that it requires little fuel. Fireclay, which occurs in coal measures, produces bricks which will withstand very high temperatures. "Pressed Blue Staffordshire" are the strong engineering bricks produced from the tough blue Staffordshire clay mixed with some crumbly stone or other clay.



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BATTERY OF GRINDING MILLS

Raw material from the pit is taken to the brickworks where it is fed into power-driven grinding mills. The horizontal pans revolve about 30 times a minute.

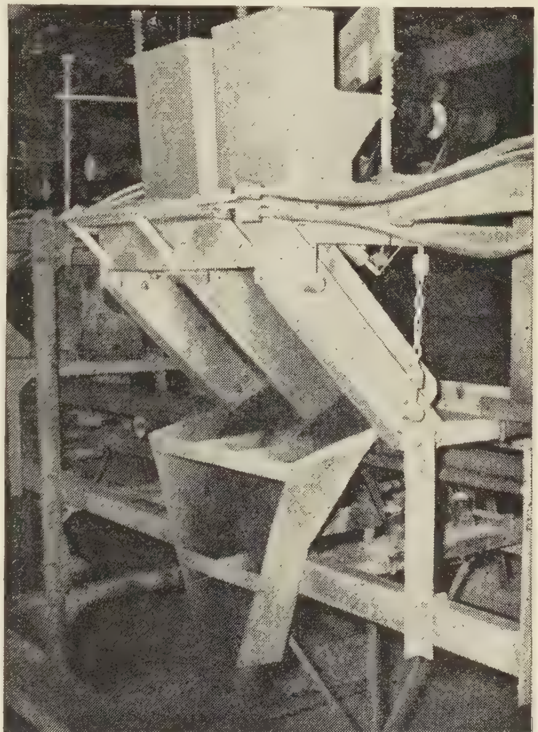
Buff, red, blue, or black bricks are produced by adding varying amounts of iron oxide to the brick earth. Clay gives yellow to white. Colour is also affected by the firing temperature.

Some brick earths can be used as they are; some contain stones which must be removed; and some require the addition of sand or ashes. The first type is dug, and then spread out in the open for a few months. It is turned over two or three times during this "tempering" or "weathering," which breaks it up and makes it crumbly. Stony clay is generally cleaned by mixing it with water in a wash mill. This is a circular tank in which harrows swing round on a central pier, break up the clay, and turn it into a slurry, or thick semi-liquid mass. The stones are left behind when the slurry is run off to be dried and tempered. Sometimes the earth is mixed to a paste and squeezed through sieves, which retain the stones. Chalk, sand, etc., can be mixed with the slurry, or spread on the clay during tempering and dug in.

Hard clays such as shale (which is a rock made of clay) can be ground in edge-runner mills. In these mills two very heavy rollers crush the clay into particles and drop it on to a revolving pan about 12 feet in diameter with $\frac{1}{2}$-inch perforations in the bottom. The clay which escapes through the perforations runs through revolving sieves which pass the fine particles on to a conveyor.

In most brickmaking processes the prepared clay is passed through a pug-mill. This is a long cylinder with a central revolving shaft to which are attached knives shaped like turbine blades. The clay is mixed with the necessary amount of water and fed in at the top. As the knives revolve, they cut the mixture again and again, thoroughly kneading it until it has an even, paste-like consistency.

The four main methods of making bricks are hand moulding, plastic or wire-cutting, stiff plastic, and semi-dry. In hand moulding a clot (or lump of clay) from the pug-mill is moulded by hand to the rough size of a brick, and then pressed into a mould. A straight piece of wood called a "strike" is drawn across the top of the mould to give an even surface. The moulds are dipped in water (in slop-moulding) or their insides are coated with sand (in sand-moulding) to prevent the clay from sticking. This method is still used in small works, and in producing ornamental bricks. In the plastic process the clay is mixed to a fairly wet paste in the pug-mill, and then forced out in one continuous strip through a mouthpiece the size and shape of the bottom of a brick. The "clot" travels over rollers to a cutting table where there is a series of wires — the distances between the wires being equal to



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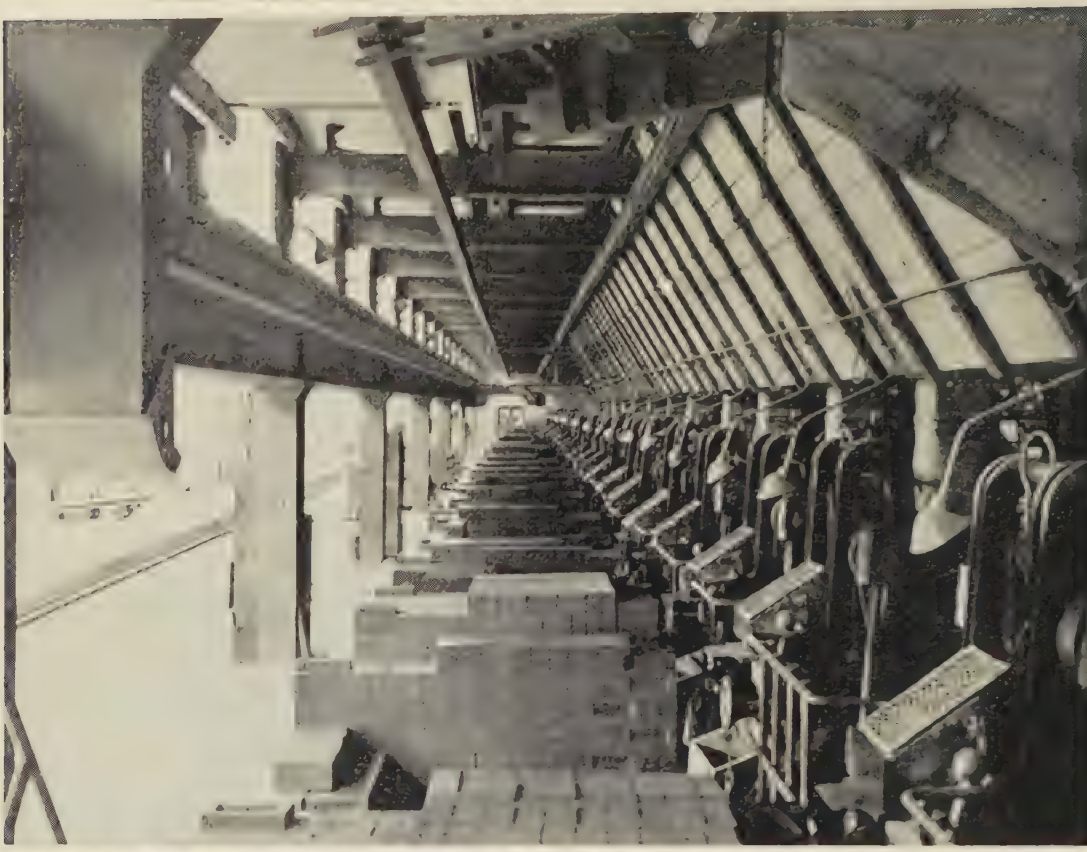
SCREENING THE POWDER

From the mills the powder is conveyed to wire screens, electrically heated to prevent clogging. The powder falls on to a conveyor belt, which takes it to the presses.

THE BRICKS BEGINNING TO TAKE SHAPE



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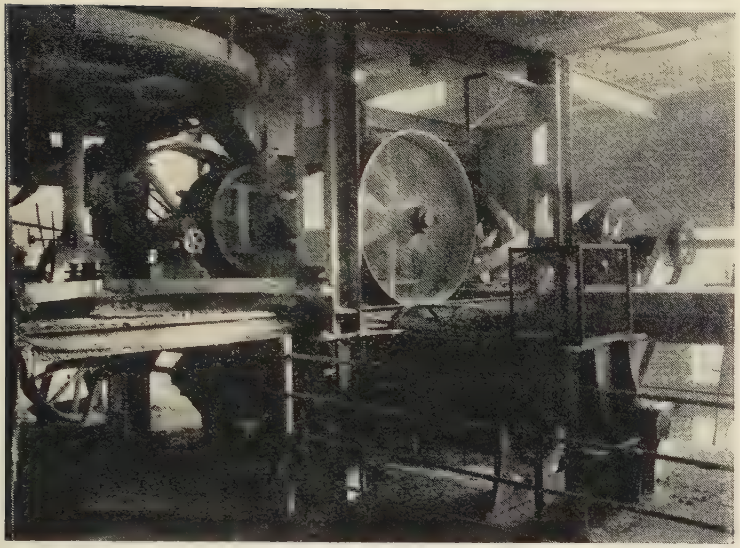
The sifted material is fed into a battery of presses (upper picture), in which it is moulded under heavy pressure between heated dies. The bricks so produced are strong enough to be loaded directly into the kiln for drying and firing. The lower picture shows the entrances to the separate ovens, which form the kiln. Each chamber can take 82,000 bricks, which are loaded into the kiln and withdrawn, after firing, by a lift truck.



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A PUG-MILL IN OPERATION

In the plastic method of brick-making, water is added to the clay in the pug-mill to produce a paste, which is forced through an outlet shaped like a brick, so that the paste issues from the machine as a long bar about nine-and-a-half inches wide and four and three-quarter inches thick.

the thickness of a brick. These wires can be pulled down to cut the clot into a number of bricks, or alternatively the clot is pushed through them. Wire-cut bricks are seldom used for facing, as their edges are too rough; but if necessary they can be re-pressed to make facing bricks.

The stiff plastic process is used with clays which can be ground to the consistency of garden soil. After the grinding and sieving process already described, water or a little dry clay can be added to the main mass to give it the right consistency. It goes through the pug-mill in the usual way; and is then fed to brick-making machines which press it into clots approximately the size of a brick. The clots then pass to a set of moulds, where they are re-pressed to their final shape, and the frog (or bottom indentation) is formed and the maker's name stamped on.

The semi-dry process is used with very dry clays. After grinding and sieving the clay should be a powder almost, but not quite dry. The powder passes through a mixer, where other varieties may be added—or a very little water if that is necessary—and conveyed to the machines. The powder is fed into moulds, which are powerful presses; and is subjected to a pressure of 80 tons, repeated four times.

Before being "fired," hand-made and wire-cut bricks must be dried by being stacked in an open-sided shed, built up in walls thatched on top, or drawn slowly on trucks through a heated tunnel. The clay from which stiff plastic and semi-dry bricks are made is so dry that they can be taken direct to the kilns with little or no drying.

The simplest kiln is a rectangular brick structure with thick walls and an arched roof. There are a number of fire-holes in each long wall, and an opening in the roof. When the dried bricks have been stacked in the kiln, fires are lit in the fire-holes; and the hot gases circulate round the bricks and pass out through the roof. The burning may continue for a week or more, at 800° C. or up to 1,500° C.

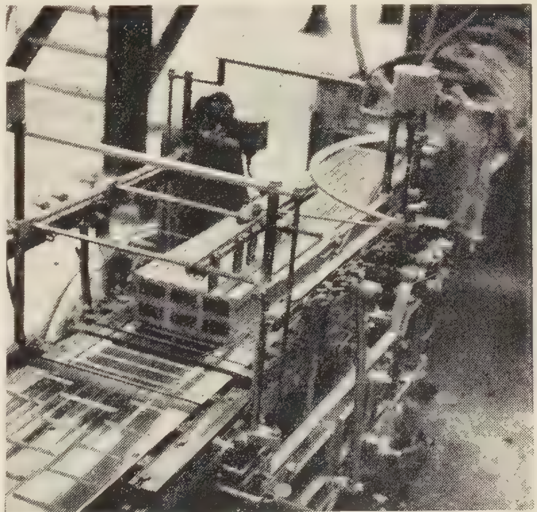
Bricks can be glazed and coloured by dipping them into a special slurry or "slip" and then firing them.

Tiles are used for roofs, floors, vertical walls, and—in an ornamental form—for panelling and fireplaces. They are essentially a form of brick; but as they are much thinner, the clay used for them must be purer and stronger. Their manufacture by hand or machine is more or less the same as in brickmaking.

Roof and wall tiles are usually 10 inches by $6\frac{1}{2}$ by $\frac{1}{2}$ inch thick, and have two projecting "nibs" at the end by which they can be hung on to wooden laths. Pantiles have a partial S section, the curves of neighbouring tiles overlapping to exclude water.

Encaustic tiles have designs made in different coloured clays. Clay is pressed into a steel mould having indentations on the bottom corresponding to the design. The resulting indentations in the clay are filled with clays of the required colours. After three days the face is scraped to bring out the design clearly. Then, after further drying, the baking begins.

The famous Dutch picture-tiles were dipped into a milky white glaze of tin oxide, and baked. The pictures were then painted on, generally in blue or purple monochrome, leaving much white or grey background. After further baking, they were often given a colourless, transparent glaze, the whole effect being very pleasant.



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CUTTING TABLE FOR BRICKS

From the pug-mill the long clay bar is conveyed to the cutting table, where the individual bricks or blocks of bricks are automatically cut off by wire cutters.

BRIDGE BUILDERS *and their* WORK

Bridge. When early man came to a river that he could not swim, he could cross it only by means of a fallen tree trunk resting on both banks, or perhaps by climbing, hand over hand, a natural rope of vine or liana, hanging from trees on either bank. But when he had learnt to make tools and use definite paths, he needed more or less permanent bridges in definite spots. He could then fell a tree on one bank so that its top rested on the other. This was the early example of the beam bridge. Or he could fasten strips of hide together to form a rope stretching between two trees on opposite banks; and hang a light footway from this rope. This was the early form of suspension bridge. Other types of bridge required a standard of craftsmanship and mechanical knowledge which was not reached for thousands of years.

The progress from these primitive shifts to the great modern engineering structures has taken many centuries, for the men of olden days could use only the materials they had: first timber, then stone, and later, after many centuries, iron, which came into commercial production only early in the 19th century. Steel and cement (the important ingredient of concrete) came later still. Moreover, to design a bridge strong enough for its job, but not too impossibly strong, required a knowledge of mechanics which was not acquired by mankind until the 19th and 20th centuries. The early bridge-builders had to rely on trial and error, judging by the bridges that lasted and those that collapsed. Considering their difficulties, they must have been great men. However, the old examples which survive are the few successes, and they must have been greatly outnumbered by the failures.

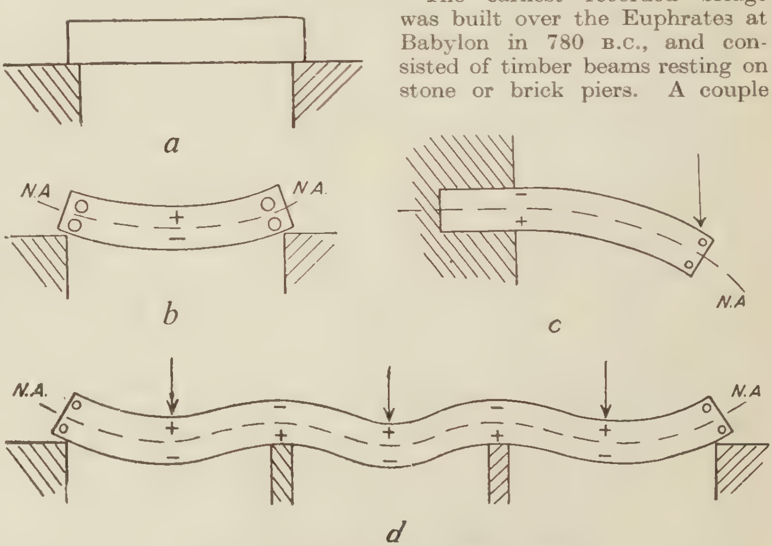
Of the five main types of bridge — beam, truss, arch, suspension, and floating—the beam bridge was the earliest. At first the beams were of timber, but now either steel or reinforced concrete is used. It is important to know what happens to a beam when it is loaded; and this can be seen from a simple experiment. Take an indiarubber and rest the ends on two books as in fig. 1*a*. Press down in the middle; and you will see that the bottom is stretched—or "in tension"—and the top squeezed in—or "in compression"—see fig. 1*b*. The tension and compression are called the stresses. From top to bottom of the beam, the compression gets less until it ceases and tension begins. This point—which in a rectangular beam would be in the middle—is called the neutral axis; there is no stress in this position.

It is at the top and bottom of a beam that most strength is needed, for there the stresses are greatest. A beam could be pared away to the shape of the letter H lying on its side, and still have ample strength; and this is done with steel beams, as will be seen later. It was early found that depth is more important than width, and that a plank is very much stronger on edge than when laid flat.

In the beam of fig 1*b* the stresses are greater in the centre of the span, and die away to nothing at the supports. Fig. 1*c* shows a "cantilever" fixed firmly at one end and unsupported at the other; and fig. 1*d* a beam resting on several supports and called a "continuous beam." As engineers generally make their bridge deepest where the stress is greatest, one can tell from the shape whether it is a supported, cantilever, or continuous beam.

As timber was plentiful and easily worked with the tools available, wooden beams were always used in the earliest times, and this continued well into Roman days. Stone is not really suitable for beams, and it is difficult to cut out and handle any long stone beam. A couple of examples have, however, come down to us. The Post Bridge, on Dartmoor, has three spans of granite slabs resting on rough granite piers, one slab being 15 feet long by 6 feet broad. This is the same age as Stonehenge, and is probably the oldest existing bridge in the world. Its only rival is the Caravan Bridge at Smyrna, a 40-foot span, the age of which is unknown. However, these may easily be the only two of this type ever built. But though stone is unsuitable for beams, it was adopted for piers at an early age.

The earliest recorded bridge was built over the Euphrates at Babylon in 780 B.C., and consisted of timber beams resting on stone or brick piers. A couple



1. HOW BEAMS BEND UNDER STRESS

Experiments, illustrated in these diagrams, show how beams react under load, or stress. Take an indiarubber and support it at either end (*a*); then exert pressure in the middle (*b*). At *c* is a "cantilever" fixed at one end and unsupported at the other; and at *d* is a beam resting on several supports. The letters *N A* indicate the "neutral axis," along which there is no stress

H. C. Adams

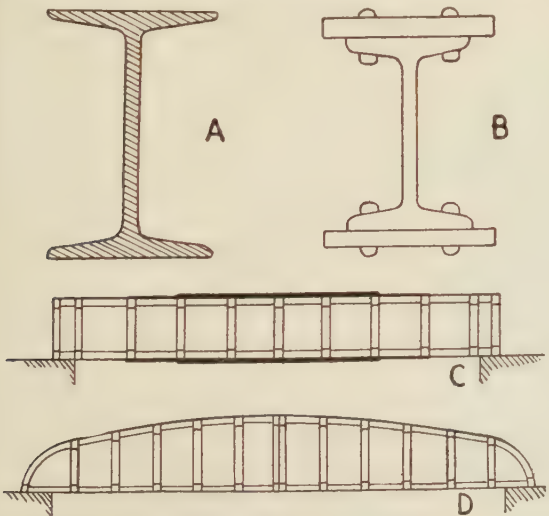
2. OLD SHOREHAM BRIDGE SPANNING THE ADUR

Where foundations are bad and the traffic light, timber is a useful material for bridge-building. Old Shoreham bridge, which is built across the bed of the river Adur, Sussex, is entirely of wood. In forested regions of North America many bridges have been built with beams supported on wooden piles or trestles, but such bridges are highly combustible.

of other early bridges are known; but the Romans were the real bridge-builders of antiquity, just as they were the first great road-makers, and the constructors of strong aqueducts. Their first known bridge was the Pons Sublicius, over the Tiber, of timber beams resting on timber piles. This was the famous bridge which Horatius held "in the brave days of old" (*see under* MACAULAY). The most famous Roman timber bridge was built on piles over the Rhine by Julius Caesar in 55 B.C. in only ten days—a marvellous piece of work.

During the Dark Ages the art of building stone arches was lost, and timber was generally used. It survived even when stone had returned, and (strange to relate) reached its peak in the days of iron and steel. The builders of very long railways in America found plenty of huge and strong trees on the site, and built many long and high bridges by using timber beams supported on trestles or piles. Timber is useful for temporary bridges and where foundations are bad and traffic is light. Old Shoreham bridge (fig. 2) is typical.

Nowadays beams are generally made of steel. Fig. 3A shows a modern rolled steel joist or r.s.j.



3. STEEL BEAMS AND GIRDERS

The rolled steel joist (A) is very widely used as a beam (B) shows a section of such a joist with flange plates attached. Girders are of many types and include the parallel plate girder (C) and the curved plate girder (D) forms.

in section—that is, endwise, but as if cut through. This is made by squeezing the hot ingot between rollers in a rolling-mill while the iron is soft. The steel is concentrated in the top and bottom flanges and in the vertical part called the "web"; and this gives maximum strength for the minimum of steel. Iron was first rolled into these shapes by an Englishman called Cord in 1783. Cast-iron was used for joists in the early 19th century; but it is too brittle and is never used now.

The rolled joist is good for bridges up to 20 or 30 feet long, but it cannot be rolled deep enough for long spans. To overcome this, engineers used the built-up type or "plate girder," shown in figs. 3B and C. These can be built of considerable depth, and are used for bridges 60 to 80 feet long. Fig. 3D shows how the depth is sometimes reduced near the supports where the stresses are small. The longest and one of the earliest plate girder bridges is the Britannia bridge built by Stephenson in 1850, which carries the railway over the Menai Strait. It is a "box" girder, like a great plate girder with two webs, one at each edge of the flanges, instead of one central web. The railway runs between the two webs. Its main spans are 460 feet, and it was a wonderful achievement for its time.

Concrete (see article) is very strong in compression and weak in tension; but by placing steel bars near the bottom it can be made as strong as required in tension. It therefore makes a good beam, very suitable for use in bridges. Concrete beams and slab bridges have come into general use only since about 1900; but they are now increasingly used for bridges up to about 60 ft. span. Concrete lends itself to architectural treatment, and concrete bridges can be made to look very attractive. Fig. 4 shows a typical concrete beam railway bridge.

As the strength of the beam finally depends on its depth, and as there is a limit to the size of log to be found, early attempts were made to build up deeper beams by fastening pieces of timber together. From this came the first discovery of the truss in the 16th century by Andrea Palladio, an Italian architect. The truss depends on the principle of triangulation, which is easily demonstrated. Take two strips of cardboard, overlap the ends, and stick a pin through the overlap at right angles. Add a third strip to complete a triangle. You will find that pushing or pulling the corners will not change the shape of the triangle: it is a rigid frame. If you have four or more strips the shape can easily

Cement and Concrete Association

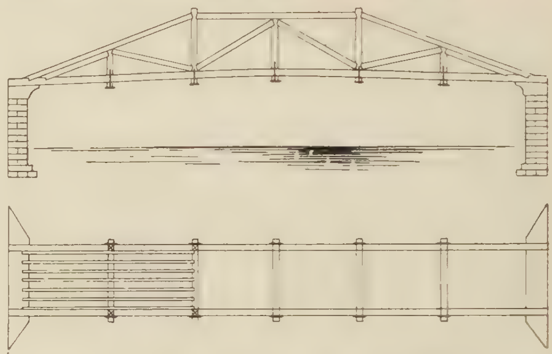
4. MODERN FORM OF BRIDGE CONSTRUCTION

Concrete beam bridges did not come into general use until about 1900, and an example of this form of construction is here seen. The bridge carries a railway over the Hindmarsh river, South Australia. Concrete lends itself to architectural treatment, and concrete bridges, however severe in style they be, can be made to look very attractive.

be changed. A truss consists essentially of top and bottom members called " chords " (which take tension and compression as in a beam) connected by vertical and diagonal members, called " web members," which, with chords, form a series of triangles. Some of the web members (" struts ") take compression, and some (the " ties "), tension. Trusses can therefore be built very deep and at the same time light ; and are suitable for long spans.

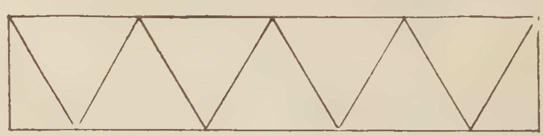
Fig. 5 shows a truss bridge of 108-foot span built by Palladio near Bassano. This is a very simple truss, mathematically correct and very modern in appearance ; and Palladio probably knew more about the mathematics of the truss than any of his successors for three hundred years. Yet in spite of its convenience and economy, the truss was entirely neglected for centuries after Palladio. Then in 1760 a carpenter called Grubenmann built a 300-foot-span timber truss bridge near Baden in Germany—the longest timber truss ever built, and a marvellous achievement for that time. Timber trusses were used increasingly after that, especially in the U.S.A. ; and the composite truss was introduced later, using sometimes cast-iron struts and sometimes wrought-iron ties. The use of timber and composite trusses became rarer in the second half of the 19th century ; and they are never used now for important bridges.

When wrought iron became freely available it was naturally used for trusses. However, little was known in the early 19th century about the mechanics of trusses, and many strange and often unsafe designs were produced. The work of Telford, Fairbairn, and Hodgkinson helped the advance of knowledge ; and when Whipple, of the U.S.A., in 1847, and Robert Bow, of Scotland, in 1850, published books on the fundamental mechanics of the truss, they put design on the right lines. Many of the early types of truss are no longer used. Fig. 6 gives the types mainly used now. The Warren is used for short spans, the Pratt for spans up to 250 ft., and the Petit for up to 750 ft. The Saltash bridge over the Tamar, built by Brunel in 1849, is an outstanding example of early daring. There are two spans of 455 feet ; and they still carry heavy railway traffic, which is a testimony



5. TRUSS BRIDGE BY PALLADIO

This 16th-century truss bridge, like those of to-day, is built up in triangles. It is deepest at the middle. The floor is on cross-bearers fixed to the uprights.



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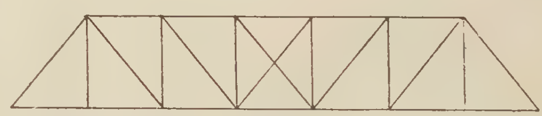

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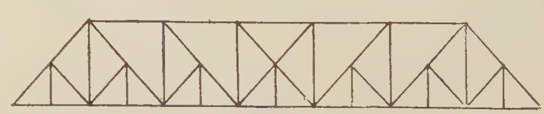


c

6. DEVELOPMENT OF THE TRUSS

In bridge-building a truss is made up of horizontal girders, with supports called posts or struts. At *a* (above) is shown an early form—the Warren ; *b*, the Pratt, is deeper and has vertical struts ; *c*, the Petit, is further strengthened by addition of inter-connecting struts.

7. THE FORTH BRIDGE: AN ENGINEERING WONDER

Begun in 1882 and opened for traffic in 1890, the Forth bridge spans the Firth of Forth, Scotland. From the engineering point of view, its construction marked an epoch in bridge-building. Its enormous spans of 1,710 feet between supports were rendered possible by the use of steel and by the cantilever design of the superstructure. The bridge is a little over $1\frac{1}{2}$ miles long, and the height of the three cantilevers over the piers is 361 feet above water.

to Brunel's genius. Spans have increased since then; the longest in 1952 was the Sciotoville bridge over the Ohio, where a continuous Petit truss extends over 755-foot spans.

Cantilever bridges are another use of the truss. Fig. 7 shows the Forth Bridge, built in 1890. Freely supported trusses span between the cantilever arms over the main channels; and the cantilevers are firmly anchored to concrete foundations. The varying heights of the trusses and cantilevers show how the stress varies from place to place. The spans between towers over the main channels are 1,710 feet, a length not exceeded until 1917, by the 1,800-foot span of the Quebec cantilever bridge.

Owing to the introduction of tanks and other heavy vehicles, truss bridges are now frequently used in war. During the First World War, the Inglis and Hopkins bridges were used; and during the Second World War the Bailey bridge—invented by (Sir) Donald Bailey—was used all over the world by the British and Allied armies. It is manufactured in 10-foot lengths, which are carried in lorries to the site. There the lengths are quickly connected by bolts to form the span required. The Bailey bridge will carry tanks over a span of 240 feet. It is quickly made up on the river bank, and launched over the gap on rollers, a counter balance weight behind the rollers keeping the nose of the bridge up. Bailey bridges over 1,000 feet long were built during the various campaigns of the war.

It is often thought that the stone arch (see article) is the earliest form of bridge, since most of the old bridges which survive are arches. In fact, the arch came many generations after the timber beam bridge, but the timber bridges soon decayed. The first important builders of arched bridges were the Romans. The first of these in Rome was built over the Tiber in 178 B.C. and was followed by at least seven others. The Pons Fabricius, of two 80-foot spans, was built A.D. 162; and under the name of the Ponte Quattro-Capi it still carries traffic—a fine tribute to Roman workmanship.

Roman arches were often built without mortar; and the voussoirs (key-stones locking the tops of the arches) fitted so perfectly that the faces might have been ground together. The Romans also developed a hydraulic lime which had the power of setting under water—rather like modern Portland cement, though not as strong. They used this for their foundations and piers, and in the course of years it has become as hard as

8. THE FIRST IRON BRIDGE

At Coalbrookdale, Shropshire, is the world's first iron bridge (above). It was built between 1777 and 1779 by Abraham Darby over the river Severn, and has a span of $100\frac{1}{2}$ feet. A similar bridge at Sunderland, Durham, had a span of 236 feet and lasted for 130 years.

THREE MIGHTY BRIDGES OF RECENT CONSTRUCTION

No. 10, Dorman Long & Co., Ltd.

The bridge over Sydney Harbour, Australia (top picture), completed in 1932, has a steel arch with a span of 1,650 feet. It carries four railway tracks, a roadway, and two footways. In the middle picture is the road bridge over the Tagus, Portugal, opened in 1951. It consists of five steel spans, and has a total length of 4,015 feet. It was built in 1,000 days. Waterloo bridge (bottom), over the Thames, London, is a fine structure of concrete arches. It was formally opened for traffic in 1945, but one side had been in use since 1942.

12. GOLDEN GATE SUSPENSION BRIDGE, SAN FRANCISCO

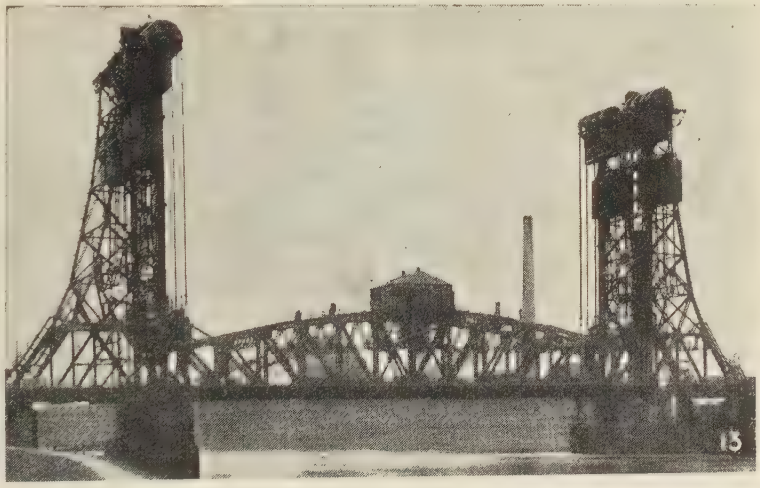
The Golden Gate bridge, at the entrance to San Francisco harbour, links that city with its Redwood Empire counties, and is a vital link in the communications on the Pacific coast of the United States. Begun in 1933, it was opened in 1937, and has a single span of 4,200 feet. It crosses a waterway 6,200 feet (nearly $1\frac{1}{4}$ miles) wide ; the towers are 746 feet high ; the roadway is 200 feet above high-water level. The suspension cables are $36\frac{1}{2}$ inches thick.

stone. They built a great number of fine masonry arches on their great military roads ; and many of these still remain. However, they did not know the modern technique of building foundations in poor soil, and during the centuries many bridges were undermined, and collapsed. Though they specialised in stone arches, they used timber for one great arch bridge. This was erected over the Danube A.D. 104, by the Emperor Trajan ; and it consisted of twenty 180-foot timber arches supported on stone piers. Pieces of timber were built up to form an arched rib ; this appears to have been the precursor of the modern braced arch.

After the fall of the Roman Empire few bridges were built until the 12th century, when a monastic body, Fratres Pontis (brothers of the bridge), devoted themselves to bridge-building. One of these, Peter of Colechurch, began the building of Old London bridge A.D. 1176, and his body was buried in one of the piers. Six hundred years later the oak piles under the piers were found to be in perfect condition. Many fine arches were built in Europe in the following centuries ; and Newton's explanation of the mechanics of the arch made design simpler and safer. In the 18th and early 19th centuries the construction of new roads, and then of railways, called for many new bridges. Such famous British engineers as Smeaton, Telford, Brunel, the Stephensons, and the Rennies, built many fine stone arches—*e.g.* the old Waterloo bridge in London, Richmond bridge in Surrey, and the Berwick bridge across the Tweed. Yet the art of the stone arch has changed little since the days of the Romans. The masonry arch is seldom built to-day, because steel and reinforced concrete are so much stronger and cheaper.

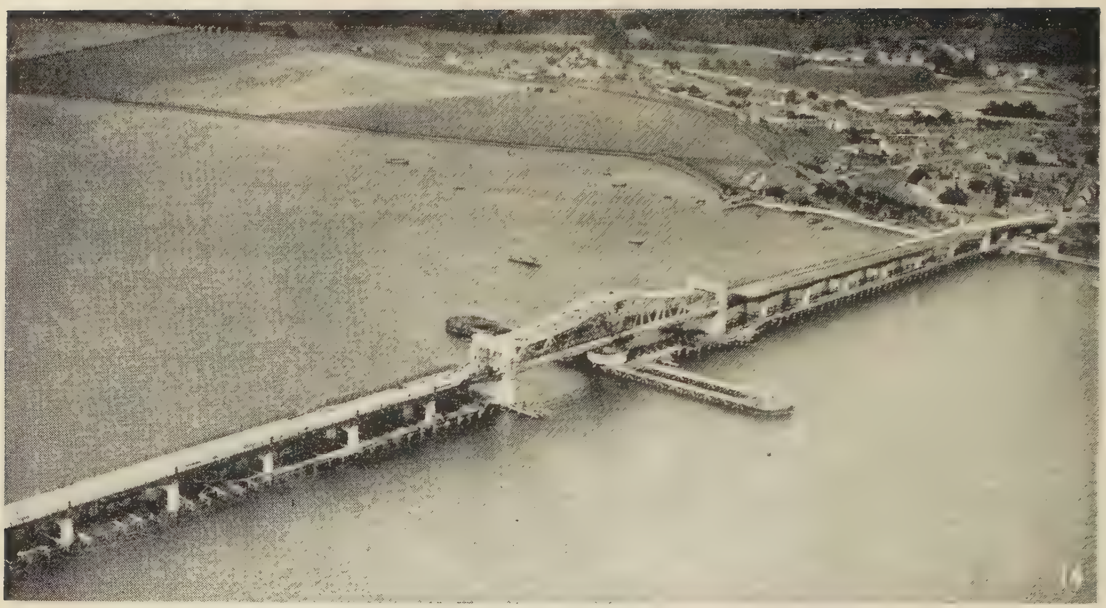
In 1777 Abraham Darby made the first break with tradition when he built the Coalbrookdale bridge over the Severn, which still exists. The roadway is carried on two cast-iron ribs of 100 feet 6 inches span. Each rib was cast in two halves, which were then erected and joined at the crown by a hinge. A similar bridge of 236-foot span at Sunderland lasted in good order for 130 years.

The masonry arch, often called the "gravity" arch, can resist only compression ; for if there were



13. LIFT BRIDGE OVER THE RIVER TEES

In congested dock areas where river traffic is continually passing, a lift bridge, such as this one spanning the river Tees at Middlesbrough, Yorkshire, is the most suitable design. The span is raised to the tops of the towers by means of steel wire cables to allow ships to pass beneath.



14. SWING BRIDGE SPANNING THE RIVER FORTH

Movable bridges are built where it is more economical to give free passage to shipping by means of an opening span in a low-level bridge than to build the whole structure at such a height as will allow sufficient clearance. In the Forth swing bridge (above) two adjacent spans rotate on a central pier to open up two waterways for shipping. The structure carries a roadway across the river at Kincardine, which is situated some five miles south-east of Alloa.

tension, the joints of the voussoirs would open. Since steel is strong in tension, steel arches are now built as curved beams which can withstand tension as well as compression—not as gravity arches. These arches are called " elastic " arches. Sometimes they are curved plategirders, but usually they are curved trusses.

Fig. 9, and also a colour plate illustrating the article AUSTRALIA (Vol. 1, page 324) show the Sydney Harbour bridge, opened 1932, whose span of 1,650 feet is exceeded by the 1,675-foot span of the Bayonne bridge at Kill van Kull, New York, completed 1931, with a 160-foot roadway that was the broadest in the world. Fig. 10 shows the Tagus bridge, completed in 1951 by the firm that built the Sydney Harbour bridge.

As reinforced concrete is strong both in tension and compression, it is suitable for the elastic arch : and many fine and often beautiful bridges of this type have been built in it. Ploughastel bridge in Brittany has the longest concrete arch span in the world—613 feet. The new Waterloo bridge in London (fig. 11), completed in 1945, is a well-known example of this type.

The primitive suspension bridge made by slinging ropes from two trees and hanging a bamboo walkway from them is still used by the peoples of some remote parts of India and South America ; but the modern suspension bridge has developed a long way from this. The first step was to replace the tree by a timber post or masonry tower. The rope passed over this, and was anchored on the landward side to a mass of masonry heavy enough to resist the pull on the rope. This meant that the tower or post had only to resist the compression resulting from the tension in the rope each side of it, and was not in danger of being pulled over. However, the lack of any materials stronger than hide or rope limited the possible span.

The next advance is reputed to have been made by the Chinese 500 years ago, when they used iron chains for a few suspension bridges. Each

15. ALUMINIUM BASCULE BRIDGE AT SUNDERLAND

The first aluminium alloy bascule bridge in the world was opened in 1948 at Sunderland, Co. Durham. The bridge spans the junction between two docks, and each leaf is about 50 feet long. Four 25-h.p. electric motors can raise the leaves in just over one minute. The Tower bridge, London, opened in 1894, is another bascule bridge.

link consisted of a long, narrow iron plate with a hole at each end through which a bolt could be passed to connect it to the adjacent links. This allowed the construction of much longer spans; but the scarcity and great cost of iron limited its use. However, when wrought iron became cheap and plentiful at the end of the 18th century, a somewhat similar method was used — though without any knowledge of the earlier Chinese bridges. In 1826 Telford built the Menai suspension bridge, of 570-foot span with similar links, and later the Conway bridge. In 1829 Sir Samuel Brown built the Berwick bridge of 449-foot span, using links made of iron rods with eyes at the end to take connecting bolts. This, however, was nearly the last of the chain suspension bridges.

16. WIDNES-RUNCORN TRANSPORTER BRIDGE

A transporter bridge is one in which a suspended road-platform travels to and fro across a waterway rather like a ferry. The road-platform itself is attached to a sort of car, which moves across the bridge. The Widnes-Runcorn transporter, which is to be replaced by an arch-type bridge, crosses the river Mersey and has a span of 1,000 feet. It links two industrial areas, one in Lancashire and the other in Cheshire.

A chain suspension bridge built at Philadelphia in 1809 was replaced in 1816 by one of 408-foot span carried by cables made of $\frac{3}{8}$-inch wire; and in 1834 Chaley built an 870-foot span wire cable suspension bridge at Fribourg. Wire cable is now universally used; for modern alloy steel and modern methods of manufacture can produce wire of a strength undreamed of a century ago. As a result, the spans have rapidly become larger and larger. The largest in the world in 1952 was the Golden Gate bridge in San Francisco with a span of 4,200 feet (see fig. 12).

The earliest floating bridge was probably made of rafts tied to each other. Later, boats were moored parallel to each other in a river, and connected by beams carrying timber decking to form a continuous roadway. Bridges of this type have been used in warfare from the earliest days; and Xerxes used them to cross the Hellespont and the Danube about 500 B.C. Later, special light types of boat known as pontoons, with light beams and decking, became standard equipment for all armies. These were meant to carry only horse-drawn transport; with the introduction of motor transport and tanks in the 1914–18 war, large steel pontoons and steel beams were introduced.

There are a few places where the level of the banks, the demands of navigation, and bad foundation conditions make any alternative to a floating bridge impossible. One such bridge carried the Cairo-Haifa railway over the Suez Canal at El Kantara until replaced by a swing bridge in 1940. The Galata bridge over the Golden Horn at Istanbul is another example. It has a length of 1,530 feet, and a breadth of 82 feet, all carried on pontoons. A length of 205 feet can be swung around through 180° to allow ships to pass. It will be noted that there is virtually no tide in the Golden Horn, and no rapid current with attendant danger of floating objects to damage the pontoons.

Bridges which carry water instead of traffic are described under the heading AQUEDUCT.

Where a road or railway crosses a river very little above water-level, some means must be provided to allow ships to pass. There are several methods. Fig. 13 shows a vertical lift bridge in which one span is lifted up to the top of the towers to allow a ship to pass under. Fig. 14 shows a swing bridge, where two adjacent spans rotate on a central pier to allow two free waterways. Fig. 15 is a bascule bridge. The lifting span revolves on horizontal pivots, and is counter-weighted to make it easy to lift. Fig. 16 shows a transporter bridge or aerial ferry which connects the Lancashire and Cheshire road systems, carrying vehicles across the river Mersey between Widnes and Runcorn.

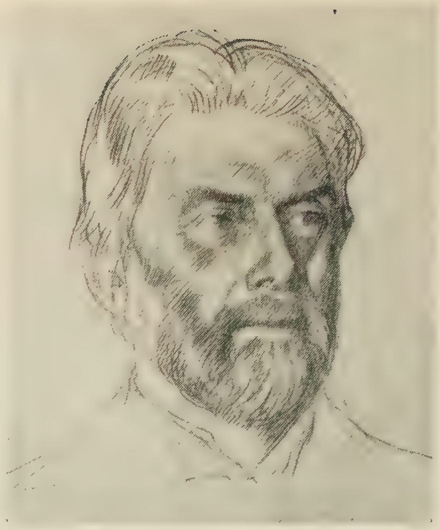
Bridges, ROBERT SEYMOUR (1844–1930). The English Poets Laureate form a mixed company, and among them Robert Bridges has a curious position. When he was appointed Laureate in 1913, his name was hardly known to the general public. Certainly he was not the kind of "official" poet who could be expected to write to order. His work, though polished, was somewhat scholarly and cold. Though he liked to experiment with musical metres and verse forms, he favoured a formal style of language that often made his poems, especially longer ones, seem remote. But many of his shorter poems show unexpected fire.

Bridges was educated at Eton and Oxford, and then studied medicine. For a time he held a post at the famous Children's Hospital in Great Ormond Street, London. He ceased to practise as a doctor in 1882, and in the meantime his earliest verse had been privately printed in Oxford. Not until 1890, when he was in middle

life, was his poetry first published in the ordinary way. Then it began to be read and appreciated by a growing group of discerning readers, but was never popularly admired in the way that, say, that of Tennyson and Browning had been.

His last long poem, *The Testament of Beauty* (1929), published when he was well over 80, sums up his philosophy, and reveals his love of Greece, of reason, and of Christianity, which he tries to reconcile with evolutionary theories. This work is considered by good judges to be his masterpiece.

He wrote one or two plays on Classical themes and devised the words of an oratorio. Spelling reform, printing, and music were other special interests of this quiet poet. The poems of his friend Gerard Manley Hopkins, a strange and original writer who died in 1889, were entrusted to Bridges for publication; but he feared that the public were not yet ready for Hopkins and did not allow the poems to appear until 1918. They then had a rapid and immense influence on the young poets of the time.



ROBERT BRIDGES

In the last year of his life Bridges produced *The Testament of Beauty,* dedicated to King George V and regarded by many as his masterpiece. He was created poet laureate in 1913.

The following is one of the best-known of the shorter poems of Robert Bridges:

I love all beauteous things,
  I seek and adore them;
God hath no better praise,
And man in his hasty days
  Is honoured for them.

I too will something make
  And joy in the making;
Altho' to-morrow it seem
Like the empty words of a dream
  Remembered on waking.

Bright, John (1811–89). As a baby, John Bright was so delicate that he was wrapped in cotton-wool, and his father told him afterwards that he had often carried him about not knowing whether he was alive or dead. Yet he grew to be a strong, healthy man, one of England's greatest statesmen, and one of the most eloquent orators and most vigorous politicians that ever took his seat in the House of Commons.

Born and bred at Greenbank, Rochdale, Lancashire, John Bright was the son of a Quaker cotton manufacturer in comfortable circumstances. Leaving school at 15, John entered his father's mill, and worked there for many years. He associated on most friendly terms with working people, and came to see life and politics always from their point of view—then a rare thing among politicians.

Bright played a great part in the agitation for the repeal of the Corn Laws, which placed on imported corn a duty varying from one shilling when home-grown corn was 73s. or more a quarter to 23s. when it was 64s. and then increasing one shilling with every decrease of one shilling in the home price. This kept high the price of bread, chief food of the people. In this he worked mainly as the able lieutenant of his life-long friend and inspirer, Richard Cobden (see article) whom he first met in 1836. When Bright's first wife died in 1841, Cobden, paying him a visit of sympathy, roused him from his sorrow by appealing to him on behalf of the women and children dying of hunger. "I would advise you," he said, "to come with me, and we will never rest till the Corn Laws are repealed."

From 1843, when he was elected an independent Member of Parliament for Durham, his name became a household word in England. He worked in every cause for the welfare of the people of Great Britain. Perhaps his greatest single-handed campaign was that which reached its highest point in the Reform Act of 1867; this placed about 900,000 men of small means on the voting list. In Gladstone's first ministry Bright became President of the Board of Trade (1868), and he again held office in 1880, but resigned over the British bombardment of Alexandria.

Bright was well called the People's Tribune (protector of the interests of the people). In campaigning for the abolition of the Corn Laws, the extension of the right to vote, voting by ballot, better education, the abolition of slavery in America and of flogging in the British army, he gained the respect and affection of the people to an extraordinary degree.

A staunch Quaker, he denounced war with all his force. Among his most famous speeches was that delivered on the eve of the Crimean War (1854–56), in which he warned the nation that "the angel of death has been abroad throughout the land; you may almost hear the beating of his wings." (See picture illustrating Cobden, R.)

Brighton. Originally the poor little fishing village of Brighthelmstone, on the Sussex coast, menaced by encroaching waves, Brighton owes its development as a watering-place to Dr. Richard Russell, an advocate of the "sea-water cure" (*see* Bathing). In the 18th century he built himself a house there, in order to supervise his patients. People flocked to sample the "cure," and to-day at the Royal Albion Hotel, the site of Russell's old home, there is a marble tablet to his memory, bearing the words: "If you seek his monument, look around."

In 1783 the Prince of Wales (afterwards George IV) visited Brighton and took a great fancy to it. Between 1784 and 1827 he built the Royal Pavilion. It is said that the Oriental style of its architecture is due to his having received the gift of some Chinese wallpaper. Whether or not this is true, it is certain that the Prince succeeded in his

REGENCY ARCHITECTURE IN BRIGHTON

The period between 1811 and 1820 when the Prince of Wales (later George IV) acted as Regent for his father George III is called the Regency, and gave its name to a fine, dignified style of architecture. These houses in Royal Crescent are examples of that style. The growth of Brighton was due to the Regent's liking for the town.

intention, which was to provide himself with a sumptuous residence. But ordinary people were taken aback by the Pavilion's domes and minarets, and William IV and Queen Victoria frankly disliked it; it was therefore regarded by most people for many years as an object of ridicule—but the 20th century came to delight in its singularity and its decorative effect.

DOMES AND MINARETS OF BRIGHTON'S PAVILION

The ornate Royal Pavilion, a weird-looking series of buildings in mock-Arabian style, was begun in 1784 and finished in 1827. Here George IV, while he was Prince Regent, held court for many years. It was purchased by the Brighton corporation in 1849, and the royal stables, now called the Dome, were converted into a concert hall.

During the heyday of the Royal Pavilion, Brighton was said to be the gayest place in Europe. It abounded in wealth, entertainments, distinguished company, and fascinating characters. Walking on the "Steine," the fashionable promenade, one might have seen many of the characters. There was, for instance, Cope, the "Green Man," so called because he dressed in green, ate only green food, and lived in a green house. Sitting in a corner, selling gingerbread, was Phoebe Hessell, who had in her youth successfully masqueraded as a soldier in the British army for five years. There were also the formidable "dippers" (*see* BATHING) of royalty, Martha Gunn and "Old Smoaker," who once pulled the Prince out of the sea by his ears for wading out too far! All these added to the fame of the town. It eventually became the fashion for young men of leisure to drive public mail-coaches from Brighton to London.

The 52-mile journey was gradually whittled down from two days to $5\frac{1}{2}$ hours. As early as 1823 some people began to make their homes at Brighton and go up and down to London quite often. With the coming of the railway this habit increased.

To-day thousands of visitors throng Brighton's streets, and not only in summer (the resident population is 156,440). There are many shops and hotels, two piers, a magnificent aquarium, and all the amenities of a popular resort. It has been a long journey from the days when the poor fishermen of Brighthelmstone were forced to ask for money throughout the country to build wooden barriers to defend themselves against their enemy the sea: the sea which eventually made Brighton's fortune and caused Thackeray to write that "kind, cheerful, merry Dr. Brighton is one of the best physicians our city [London] has ever known."

Brisbane. In 1824 Sir Thomas Brisbane, then governor of Australia, sent an expedition to northern Australia to found a convict settlement on some land 15 miles from the mouth of a river flowing into Moreton Bay. The river had not been explored before, and it was called after Sir Thomas, as was the settlement founded by his order. The governor would not know the place to-day, for the convict settlement has become the capital of Queensland, and one of the loveliest cities in Australia. Brisbane borders on the tropics. Roses bloom all the year round, and flowering trees make the city a blaze of colour. Although Brisbane is 15 miles from the sea, its port is used by ships from all over the world. The city is well planned, with the streets running at right-angles, and there are many imposing buildings, including the parliament house, two cathedrals, the city hall, the museum, and the University of Queensland (founded 1909). The

city's wealth comes from the export of cattle, sheep, wool, dairy produce, sugar, and canned fruit. Railways connect Brisbane with all parts of Australia, while the airport is one of the finest in the Commonwealth. In 1924 Brisbane amalgamated with a number of surrounding suburbs and villages to form what is now called Greater Brisbane, with a population of 424,000.

Bristol. From the dawn of its history Bristol has been a trading centre. Situated at the junction of the Avon and Frome rivers, it is both a seaport and a manufacturing town, ranking as a county in its own right.

Supreme among Bristol's buildings is St. Mary Redcliffe, called by Queen Elizabeth I "the

Government of Australia

PUBLIC GARDENS IN ANZAC SQUARE, BRISBANE

The capital and principal port of the state of Queensland, Brisbane is situated on the river of that name, about 15 miles from its mouth, though vessels of large tonnage can tie up at its quays. Among its exports are livestock, dairy produce, sugar, and canned fruit. The climate is sub-tropical, and the average maximum temperature is 78 degrees Fahrenheit. The city was founded in 1824, as a penal settlement, by Sir Thomas Brisbane, after whom it is named.

BEAUTY OF BRISTOL IN GORGE AND IN STONE

Clifton is a western suburb of Bristol, and there the Avon flows through a wooded gorge. A magnificent suspension bridge (above), which was partly constructed of material from the old Hungerford bridge, Charing Cross, London, spans the river. Built by the British engineer Isambard Kingdom Brunel and opened in 1864, it is 702 feet long and 275 feet above low-water level. At Clifton is Clifton College, a public school for boys, founded in 1862.

Royal York Crescent (above), perhaps the best-known example of Regency architecture in Bristol, was once a fashionable residential thoroughfare, guarded by a uniformed official from invasion by vulgar sightseers. It is believed to be the biggest crescent in existence, and has a frontage of 1,240 feet. It was begun in 1791, but not completed until 1824. The stone steps lead to a flagged walk, which forms the roof of the stables or garages at street level.

fairest, the goodliest, and the most famous parish church in England." This church was built in the 13th century, while much of the cathedral dates back to the middle of the 12th, although the nave was built in the 19th century. The bright painting of the monuments and carving makes the interior very striking. Other fine churches are St. Stephen's, St. James's, and the Mayor's Chapel. Temple church was burned out in 1940. Bristol University grew out of University College, founded in 1876. Bristol Grammar School was founded in 1531. The Theatre Royal, home of the Bristol Old Vic Company, was opened in 1766 by David Garrick, and is the oldest existing theatre in England. Cabot Tower on Brandon Hill in the west of the town commemorates the voyage of John Cabot (see article).

About A.D. 1000 a Saxon settlement began to grow up just here, at the junction of the two rivers, and by the time of the Norman Conquest in 1066 it had attained considerable size and importance. In the 12th century William of Malmesbury describes the port as being full of ships from every part of Europe. From Bristol the Cabots sailed in 1497 on their voyage "to seek out, discover and find" unknown lands, to be rewarded on their return with the sum of £10! During the Civil War Bristol championed the cause of Parliament, but it was captured by the Royalist forces in 1643 and was not recovered by the Parliamentarians until 1645. Bristol fishermen settled Newfoundland, and the city was the home of Admiral Penn, father of the founder of Pennsylvania. Southey and Thomas Chatterton were born here and Coleridge lived here as a young man. Bristol was also for centuries the chief English port for the trade in African slaves, its prosperity growing with the tobacco, slave, and general trade with America.

For many years Bristol has been famous for a wide range of industries which includes glassworks, potteries, soapworks, tanneries; tobacco, jam, chocolate, and paint factories; and shipyards. Here was built, in 1837, the *Great Western*, the first steamship constructed specially to cross the Atlantic. Bristol is a centre of the aircraft industry, and a maintenance base for the British Overseas Airways Corporation's fleets operating on North American and Australian routes is at Filton, just outside the city. At Long Ashton, to the west, is an important agricultural research station.

As large vessels could not get up the Avon to the centre of the city, the corporation bought land at the mouth of the river, and there, calling the place Avonmouth, they built extensive docks, to which there is a fine road affording glimpses of magnificent scenery. The corporation also owns docks at Portishead. The city includes Clifton, famous for its suspension bridge, beautiful downs, and its public school, Clifton College. Of all England's big centres of population, Bristol is perhaps the most pleasantly situated.

Much damage was caused to the city by German bombing during the Second World War (1939–45). Bristol's population in 1951 was 442,281, making it the seventh largest city of England.

The Bristol Channel is the largest inlet of the British Isles. Partly separating England from Wales, it receives the Severn, Wye, Avon, and other rivers; it has a length of about 85 miles, and a breadth varying between five and 43 miles.

The BRITAIN *that the* ROMANS KNEW

Britain. The name Britain for the island that includes England, Scotland, and Wales was used many hundreds of years before the present names were even thought of. Who were the people who lived in the British Isles tens of thousands of years ago, who hunted the wild animals with weapons made of stone, and lived in caverns and caves by the sea-shore, and in rough shelters in the forests? They resembled the other prehistoric peoples who lived on the continent of Europe.

The earliest men came over on foot, before the Strait of Dover had opened between the North Sea and the Channel, but Britain has always attracted Continental peoples, and the British people of to-day consist of the descendants of successive invaders from Europe—peaceful or warlike—who landed on the island's shores. Settlers coming between 2500 and 2200 B.C. brought improved stone weapons and also introduced the custom of burial in long barrows or in tombs built of huge stones. The predominant people in Britain at this time were small and dark. Towards 1900 B.C. another people, called by archaeologists the Beaker folk, from the kind of pottery they brought with them, arrived from the lower Rhine. They were a vigorous, tall, and warlike folk and they conquered many of their predecessors. They kept touch with the Continent and it was through their trade connexions that the knowledge of how to make metal tools came to the island, and what is called the Bronze Age began in Britain.

The greatest monuments of prehistoric Britain, Stonehenge and Avebury (see articles), date back to about 1800 B.C. and testify to the religious beliefs of the Beaker folk and to a technique in dealing with great stones inherited from the Long Barrow folk. The ditches were dug out with antler picks and the stones dressed with stone tools. It is not known what language these people spoke, but it is thought that it may have been the early Celtic tongue now represented by the Gaelic of Scotland and Ireland. More immigrants drifted into Britain during the Bronze Age, but the various elements were gradually settling down together. Not until about 500 B.C. did tribes using iron weapons and tools arrive to drive their predecessors into the north and west of the island. The Iron Age folk came in three invading waves, the second and third coming in about 300 B.C. and 75 B.C. respectively. With the Iron Age came the Brythonic language, which was the ancestor of Welsh.

In the years 56 and 55 B.C., however, the Roman general Julius Caesar (see article) was campaigning in Brittany and along the Channel coast of Gaul, and he discovered that the tribes there received help from their Celtic kinsmen on the island opposite and that leading Gauls who did not want

HOW PREHISTORIC BRITONS LIVED BETWEEN THE ICE AGES

In the south of England remains have been found of the ape-like people of what is known as the Mousterian culture, and they may be counted among the earliest inhabitants of the British Isles. They belonged to the period between the second and third Ice Ages. An imaginative reconstruction of the scene outside the cave-home of a family is shown above. The discovery of fire and of the value of animals' skins to keep out the cold enabled this race to survive.

to settle down under Roman rule were apt to take ship and disappear across the Channel. So he made his two expeditions to the mysterious island in 55 and 54 B.C., partly to teach the natives that Rome must be treated with respect, partly to discover if Britain was a rich land worth conquering.

Nothing came of his expeditions, and it was not until nearly 100 years had passed that the emperor Claudius decided to conquer the island. So the general Aulus Plautius arrived with an army A.D. 43 and began the conquest in earnest. He conquered the chiefs, foremost of whom was Caractacus, one of the sons of Cunobelin (the Cymbeline of Shakespeare's play), and the work was completed by Agricola, who was governor from A.D. 78 to 84. In the years between occurred the revolt under Boadicea (see article).

Agricola took an army into Scotland and defeated the wild tribes in that country, but he did not attempt to bring them under the rule of Rome. About A.D. 122 the emperor Hadrian, who visited Britain, was responsible for the building of a great wall between the Tyne and the Solway.

The Romans occupied Britain as soldiers and officials. They did not come as colonists; but they taught the Britons the advantages of civilization, of comfortable houses, and baths, and handsome towns. Britons of the southern half of the island were ready enough, after the first years of resistance, to share the advantages of the Roman Empire. Indeed, King Cunobelinus and his sons had already gone some way towards the adoption of Roman ways. Roman roads, many of which, like Stane Street on the South Downs, can still be seen,

AN EARLY MAN LOOKS OVER THE THAMES VALLEY

This reconstruction of a scene in the early life of man in the British Isles can be seen in the Geological Museum, London. It shows the Thames valley during a warm interlude in the Great Ice Age, about 100,000 years ago, when forests covered the land. Fossil remains prove that elephants, rhinoceroses, and other animals now only found in tropical countries, were native to England. The Early Stone Age man killed animals for food by throwing flints.

were built throughout the country, improved methods of agriculture were adopted, forest land was gradually cleared, large areas of the Fens were drained. New towns like Londinium (London) sprang up, or old squalid Celtic ones like Verulamium (St. Albans) were rebuilt with fine houses and public buildings. In the peaceful countryside well-to-do Romanised Britons built the farms and country houses which we have come to call "Roman villas" and of which the best example is Chedworth, in Gloucestershire. People learnt to read and write. Finally, Christianity came to the shores of Britain.

But in the hilly lands of Wales and the north the Roman civilization took very little root. The Britons lived in their scattered villages just as they had always lived, and their way of life changed little, though they were ready enough to use the good Roman pottery they could buy on their rare trips to the towns. The military forces of the province were kept in these regions, the legions in the great base fortresses of Caerleon, Chester, and York, and the other troops in smaller forts scattered among the hills, or in the mile-castles built along the frontier of Hadrian's Wall.

The Romans made expeditions into Scotland. Indeed, the emperor Severus got nearly as far as Aberdeen, and air-photography has revealed some of the camps he used on the way. For about 40 years the line from the Forth to the Clyde was held by an earthwork called the Antonine Wall, but this outer wall led a precarious existence, and it was Severus himself who decided that the real frontier should again be Hadrian's Wall.

When the Roman legions were withdrawn about 410, there followed a time of trouble for Britain. Even before the last of the Romans had gone, invaders from across the North Sea had begun to harry the coasts. The Britons, after nearly 400 years of security under the powerful rule of Rome, were poorly equipped for warfare. Early historians say that piteous appeals were made to Rome for protection. But Rome by this time had troubles enough of its own, and a defenceless Britain was soon left to its fate.

The Picts from the north broke down the Roman wall in Northumberland, and did great destruction, coming far down into South Britain, but they afterwards went north again. The Scots from Ireland harried the west coast and some of them invaded and settled in the west of Scotland. The Saxons and Angles from north-west Germany next invaded the country from the south-east.

The Britons regarded them at first as convenient allies who would help to fight the enemy from the north. But they were soon disillusioned. The Angles, Saxons, and Jutes, all Teutonic tribes more or less akin to one another, were quick to recognize that Britain was virtually defenceless. The earlier comers were soon followed by a constant stream of similar invaders, determined to overcome all opposition and settle in possession of the country.

For over 150 years there was continuous warfare. The legends of King Arthur (see article) and his knights make it clear that the Britons, when they realized that help would not come from Rome, fought manfully to resist the invaders; but their struggles were in vain and many of them were driven into the far south-west of England and into Wales to join their ancient kindred who had sought

HADRIAN'S WALL, NORTHERN FRONTIER OF ROMAN BRITAIN

Erected by the Roman emperor Hadrian about A.D. 122 to protect northern Britain from attacks by the warlike Picts, this Roman rampart was about 73½ miles long and extended from Bowness, on Solway Firth, to Wallsend-on-Tyne, Northumberland. Originally it was probably about 18 feet high and from 6 feet to 9½ feet thick. At intervals of about a Roman mile, mile-castles (small forts) were built to house the troops who kept patrol along the wall.

VAPOUR TRAILS OF FIGHTERS IN THE BATTLE OF BRITAIN

One of the decisive battles of the Second World War, the Battle of Britain was fought by the German *Luftwaffe* and the Royal Air Force in the air above the English Channel and southern England through July, August, September, and October, 1940. The German attack was launched first against shipping in the Channel and the Channel ports ; next, fighter stations in southern England were attacked ; and, lastly, London became the principal target. Primarily, the German aim was to destroy the R.A.F. in preparation for a full-scale invasion.

refuge in these mountains many centuries before. The Angles and Saxons took possession of almost the whole country, setting up small kingdoms they called Kent, Sussex, East Anglia, Wessex, Northumbria, Essex, and Mercia. Almost everywhere the Latin language, Roman civilization, and Christian religion disappeared and were replaced by Teutonic speech and institutions. Christianity, however, was reintroduced in 597 by Augustine (see article).

In 829, Egbert, King of Wessex, became overlord of all the English kings, and so may be regarded as the first King of England. The later history of Britain is told under the headings ENGLAND, SCOTLAND, WALES, and (from 1707) UNITED KINGDOM.

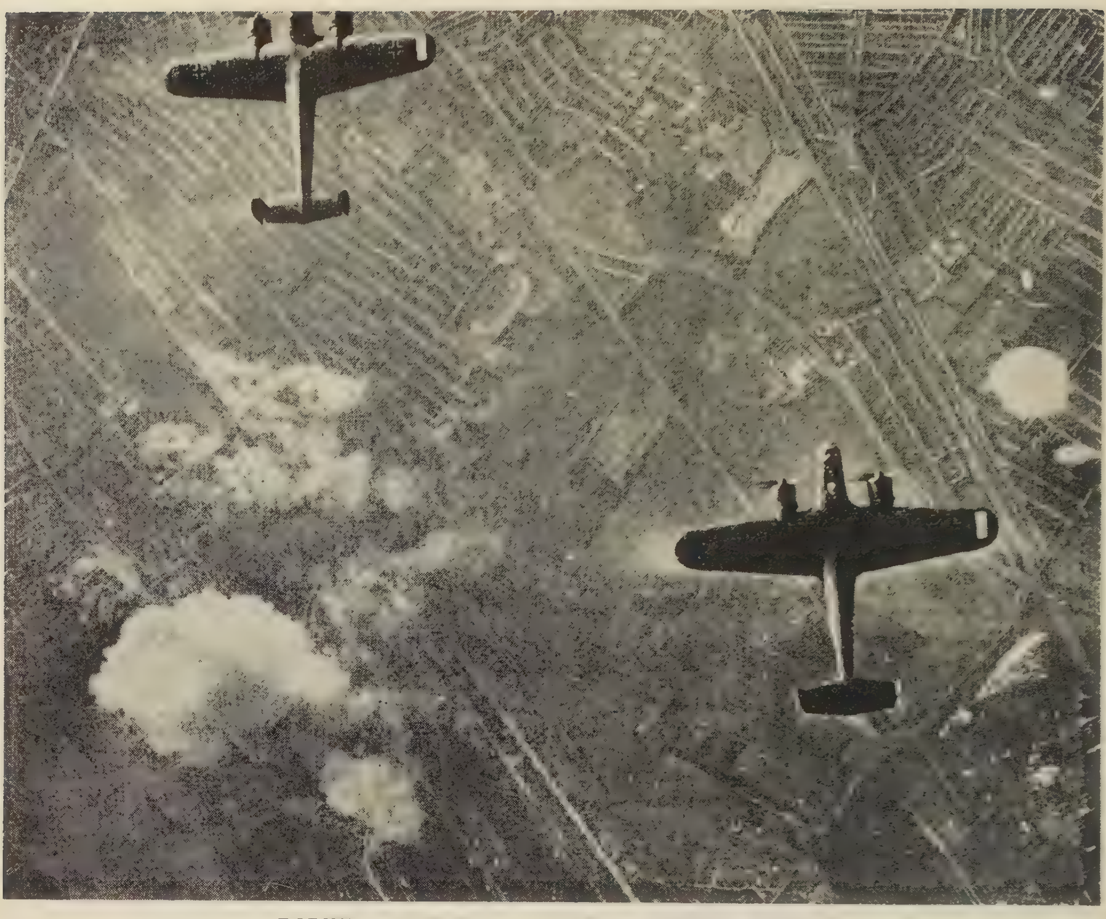
Britain, BATTLE OF. In the June of 1940 the United Kingdom alone remained in the fight against Nazi Germany and Fascist Italy. Germany had beaten and divided Poland, overrun Denmark, Norway, the Netherlands, and Belgium, driven the British armies from the Continent, defeated France and gained possession of her Channel and Atlantic coasts. If only the United Kingdom could be defeated by Hitler, he had the prospect of making his country supreme in western Europe within a year from the outbreak of the Second World War.

After the French signed an armistice with Germany on June 22, and with Italy on June 24, Great Britain lay waiting. The German *Luftwaffe* (meaning air weapon, as the Germans called their air force), elated after a series of easy victories, now threatened her from aerodromes near the European coast all the way from North Cape to Ushant. Barrage balloons, tethered about London and other large towns, were run up to keep enemy aircraft well up in the air so that they would be easier targets for anti-aircraft guns and the fighters of the Royal Air Force, and also to make any attempt at dive-bombing almost suicidal.

The weather was clear and warm ; the early summer flowers in the London parks had never been lovelier as the windows of government offices were barricaded with heavy wire netting against entry by possible parachutists. Workers in Air Raid Precautions (soon to be renamed Civil Defence) remained continually on the alert ; tank traps were dug ; concrete and timber obstacles intended to hold up invading tanks were hastily improvised on the roads ; steel and concrete strongpoints were built at cross-roads, by bridges, and at other strategic spots. Ordinary civilians continued to do their usual work, in an atmosphere of tense unreality. The great majority of children had already been sent, just as war began, from the big towns to places of greater safety in the country.

Hitler occupied the Channel Islands without opposition on July 1 ; but the British still waited, making no sign of readiness to surrender. And on July 10 began the great air battle over the English Channel and southern England that came to be called the Battle of Britain.

There had been German air raids earlier on, but this was the beginning of concentrated attacks intended to prepare the way for invasion by troops in the barges which Hitler had assembled at all the ports and river mouths of the Netherlands, Belgium, and northern France. The Dutch said that the statue of Admiral de Ruyter—who in 1667 sailed up the Thames and burnt Chatham dockyard—smiled grimly as it looked out from the sea-wall of



DORNIER BOMBERS ATTACKING LONDON'S DOCKS

On September 7, 1940, German bombers made a daylight attack on the London dock area. Smoke can be seen rising from fires started by bombs dropped in the neighbourhood of Beckton gasworks. Some 375 German bombers and fighters took part in the raid, which was the beginning of the so-called Battle of London. The Dornier 217 at that time was one of the standard bombers of the *Luftwaffe*, and was usually powered by two radial engines of 1,600-h.p.

Flushing and observed the kind of craft gathered in the Scheldt and the kind of seamanship with which the Germans hoped to invade England.

In July 1940 the Germans had about 5,000 first-line aircraft in action ; the Royal Air Force had some 750 fighters—22 squadrons of Hurricanes, 20 of Spitfires, 8 of Blenheims, 2 of Defiants. The Defiants were suitable only for night work or to attack bombers which had no fighter escort. The Blenheims had too low a speed to be of much use in the daytime and were not designed for night flying. Both Hurricanes and Spitfires had bullet-proof windscreens, and front armour between the top of the engine and the windscreen, rear armour directly behind the pilot. The Hurricane (designed by Sydney Camm) was comparatively slow—it could fly at 300 miles an hour or a little more and was not equal to the German machines it had to fight. The Spitfire (designed by R. J. Mitchell), with a maximum speed of 365 miles an hour, was probably superior to anything the Germans had at the beginning of the battle, and on the Spitfires fell the heaviest fighting. New Spitfires were made as fast as possible—which was not nearly fast enough because at that time there was only one drop hammer in the U.K. that could forge the Spitfire crankshaft. The German fighters used in the battle were the Messerschmitt 109 and 110, and the Heinkel 113 ; bombers were the Heinkel III, several Dornier types, and the 290-m.p.h. Junkers 88.

The Germans developed their attack in three phases. First came a series of attacks on shipping in the Channel and on the Channel ports. The heaviest of these was on August 8, when about 280 German aircraft came over. Some 45 were destroyed that day by Royal Air Force pilots who, with no regard for their own safety, flew right into the German formations and broke them up, disorganizing them so that they turned back in disorder. On August 12 the second phase began—that of attacks on aerodromes. Manston, Hawkinge, and Lympne, the three advanced aerodromes of Fighter Command, were so heavily bombed and machine-gunned that they were for the time being abandoned. At Kenley and Biggin Hill direct hits were scored on shelter trenches, and altogether the damage done to fighter aerodromes was very serious—much more so than the people of Britain realized. The Germans also, fortunately, did not realize how much success

HOW GOES THE BIG BATTLE IN THE SKY?

During an air raid civilians were expected to take cover in a trench or shelter, and many children, far from being frightened, watched the air battles with the keenest interest, and, on the following morning, collected shell splinters as souvenirs. Most of the fighting took place at such a great height that the aircraft themselves were invisible to the naked eye, and watchers could only follow the pattern of vapour trails drawn across the sky by the fighters.

they had had, and on September 11 switched their main attack to London. The capital was not the only target, but it was the main one, and the enemy hoped to break the city's spirit.

This phase was heralded by a daylight attack against the London docks on September 7 by 700 bombers and fighters; 40 were shot down, 13 others were damaged. The bombers returned in the dark, and continued to attack until dawn; 306 civilians were killed and 1,337 were seriously injured. For 57 nights from September 11, London was bombed every night, sometimes heavily, sometimes less heavily, but always with sad damage and loss. During September 5,730 people were killed, nearly 10,000 others seriously injured.

The Germans intended to deliver a knock-out blow by destroying the heart of the British Commonwealth; but, strong as their air force was compared with the R.A.F., they did not possess the power needed to destroy from the air so scattered and well-defended a city as London. Although not more than about 250 R.A.F. fighters were in the air at any particular moment, compared with a German average during battle of 400 aircraft, Fighter Command proved too much for the *Luftwaffe.* Air Chief Marshal Sir Hugh (later Lord) Dowding, commander-in-chief of Fighter Command at the time of the battle, said in his despatch on it (written August 20, 1941, published 1946), "The situation was critical in the extreme. Pilots had to be withdrawn from the Bomber and Coastal Commands and from the Fleet Air Arm and flung into the battle after hasty preparation. The majority of the squadrons . . . were fit only for operations against unescorted bombers. The remainder were battling daily against heavy odds. The indomitable courage of the fighter pilots and the skill of their leaders brought us through the crises, and the morale of the Germans eventually cracked because of the stupendous losses which they sustained."

Losses of the Luftwaffe

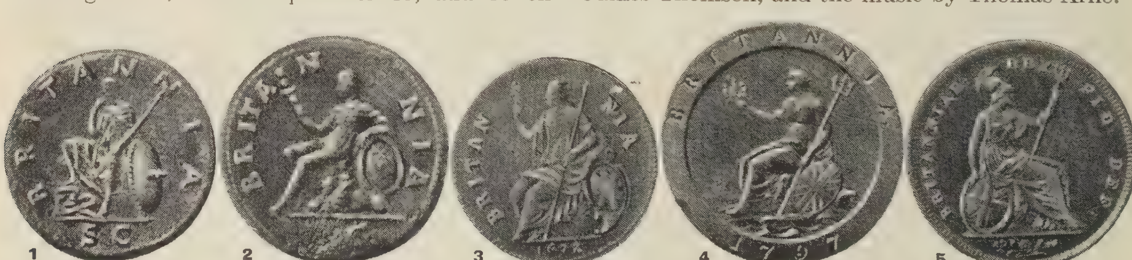
According to German records found by the Allies in Germany after it was conquered, from July 10 to October 31 (when the Battle of Britain was considered to end) 1,733 German aircraft were destroyed and 643 damaged. (Together these figures total one more than the original R.A.F. claim of German aeroplanes destroyed.) The largest numbers destroyed by fighters and anti-aircraft fire in one day were 76 on August 15, 71 on August 18, 56 on September 15, and 55 on September 27. The R.A.F. lost 915 machines, including those destroyed on the ground; 1,495 pilots and other R.A.F. personnel were killed. More than 14,000 civilians were killed and another 20,000 seriously injured. But the first major air battle ever fought by men had been won by the R.A.F., and the failure of the *Luftwaffe* to win control of the air over Britain, coupled with the dominance of the Royal Navy on the sea, made invasion by German ground forces impossible.

A chapel in Westminster Abbey, London, with a window unveiled on July 10, 1947, by King George VI, was set aside as a memorial to the members of the Royal Air Force who died in the Battle of Britain. Their names are entered on a Roll of Honour kept in the chapel, to be a perpetual reminder of the gallantry that saved Britain, Europe, and perhaps the world, from the evil rule of German National Socialism. As Winston S. Churchill, then Prime Minister, said in the House of Commons on August 20, 1940, in one of the most memorable of his many inspired phrases: "Never in the field of human conflict was so much owed by so many to so few."

Britannia. The ancient Latin historians, who wrote while the Romans occupied the island of Britain, always described the country as Britannia. The name, however, is much older even than Roman times, and may be Celtic in origin, but its exact form is a matter of dispute. It is nowadays applied to an armed female figure symbolising Britain.

Britannia on British coins was first seen in the time of the emperor Hadrian, and reappeared on modern copper coins in the reign of Charles II. The artist then used for his model Frances Teresa Stewart, Duchess of Richmond and Lennox. On Victorian coins Britannia appears seated, holding the trident of Neptune in her left hand and a shield with her right, the sea at her feet, the Eddystone lighthouse on the left, and a ship on the right. The ship and the lighthouse were omitted from the designs for the Edward VII and George V coinage, but on the George VI coinage the lighthouse was restored in the same position as it had occupied on Queen Victoria coins.

As a symbol of the people of Britain, Britannia was to some extent displaced in the 18th century by the more representative figure of John Bull. But to that century belongs also the patriotic song "Rule, Britannia!", which has never lost its popularity. The words of this song are by James Thomson, and the music by Thomas Arne.



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BRITANNIA ON BRITISH COINS

The figure of Britannia was based on the design of British coinage in Roman times. Here are shown (1) a coin of the Roman Emperor Hadrian (A.D. 76–138), and (2) one of his successor, Antoninus Pius (A.D. 86–161); then for comparison Britannia (3) on a Charles II halfpenny of 1672; (4) on a "cartwheel" penny (so called because of its heavy rim) of 1797; and (5) on a penny of 1825, where the figure, in a later form, faces in the opposite direction.

British Columbia, CANADA. Forest-clad, snow-capped mountains cover nearly all of British Columbia, the "Sunset Gateway" province of Canada. Through the deep gorges and valleys between the mountains flow many swift, turbulent rivers, turning and winding with an abruptness unparalleled in any other region of the world, as they seek their way to the sea. Here and there the mountain walls draw apart, leaving fertile valleys and table-lands.

On the side bordering the Pacific the mountains have been partially submerged in past ages, giving British Columbia one of the most remarkable coast-lines in the world. Deeply cut, like the coast of Norway, by sounds, inlets, and fjords walled by stupendous precipices, it measures some 7,000 miles. The tops of some of the submerged mountain masses stand above the surface of the ocean as islands thickly fringing the entire length of the coast.

Vancouver Island, with its area of 12,408 square miles, its wealth of timber, and its rich deposits of coal, iron, and copper, is an important part of the province. At the southern tip of the island is the capital, Victoria, and on the mainland across the strait are two other chief cities—Vancouver and New Westminster. (See map in CANADA article.)

The two main mountain systems are the Coast Range, rising from the Pacific to an average height of 6,000 to 8,000 feet, and the Rocky Mountains on the eastern side, where many of the peaks tower 11,000 and 12,000 feet above sea level. The highest peak in British Columbia is Mount Fairweather (15,300 feet), on the border of Alaska. Between these two systems lie other less extensive ranges, notably the Selkirks, the wooded slopes and enormous glaciers of which attract thousands of tourists. Stretches set aside as national parks and reserves are becoming the Alpine playground of Canada.

To the west of the Rocky Mountains is a remarkable valley, 800 miles long and from one to six miles wide. In this rise seven of the great Pacific coast rivers, among them the Columbia, Kootenay, Fraser, and Finlay. The two most important are the Fraser, which has its whole course within the province, and the Columbia, of which only the upper portion is in Canadian territory.

Untold mineral wealth—coal, gold, silver, copper, lead, zinc, and iron—lies locked in the depths of the mountains. The mines of British Columbia produce 98 per cent. of the lead and zinc, 66 per cent. of the copper, and 20 per cent. of the gold and silver mined in all Canada.

Unlimited water-power is provided by the network of streams and lakes. The 1950s saw a magnificent feat of engineering in the wild mountain country some 400 miles north of Vancouver, where the outflow of a 150-mile-long chain of lakes was harnessed to provide power for a giant aluminium plant at Kitimat. Here, at the head

National Film Board

APPLE ORCHARDS BESIDE LAKE OKANAGAN

Extensive areas in southern British Columbia are devoted to fruit growing ; and in this picture the apple orchards can be seen on the level ground between the hills and Lake Okanagan. Fruit of the highest quality is produced in the Kootenay and Okanagan districts, which have a high average temperature and an abundant rainfall. One of the province's chief natural resources is timber, and the forests contain immense reserves of softwoods, such as fir and pine.

VANCOUVER, CITY AND SEAPORT OF BRITISH COLUMBIA

Situated on a magnificent harbour on the southern shore of Burrard Inlet, Vancouver is a modern city, as most of the buildings have been erected since a widespread fire in 1886. The principal industry is shipping, for which there are spacious docks ; but the city is also a centre of the lumber trade. In the background of this picture is North Vancouver, connected with Vancouver by ferry and backed by superb scenery. It is a popular holiday resort.

of a navigable inlet of the Pacific, a new town has sprung up, and a major new industry has come to the province. Ships arrive laden with bauxite (*see* ALUMINIUM), and depart with aluminium ingots.

British Columbia, though settled so much later than other parts, is now one of the chief manufacturing provinces of Canada. Many of its industries are naturally based on local produce, and include sawmilling, pulp and paper making, fish curing and packing, shipbuilding, manufacture of fertilisers, veneer, and plywood. A pipeline to Vancouver from the oilfields of Alberta was completed in 1953.

The province contains the largest reserves of softwoods in the British Commonwealth, chiefly Douglas fir, western red cedar, Sitka spruce, western white pine, and hemlock. All these trees grow to a gigantic size, and Douglas fir, which is not found elsewhere in Canada, is often 300 feet high and 15 feet in diameter.

In the value of its fisheries British Columbia leads all the other provinces, and along the coast are some of the world's largest salmon canneries.

Much fine farming and grazing land is found in the valleys and about the river mouths and on the lower plateaux and terraces of the interior. It is estimated that there are about 25,000,000 acres suitable for cultivation. The greater part of this has still to be developed. Fruit of the finest quality is produced is the southern valleys, notably the Okanagan and Kootenay districts in the south-east, while grains thrive in the valleys farther north.

Irrigation is necessary in many parts of the interior, because the warm winds from the Pacific deposit most of their moisture on the western slopes of the Coast Range and pass eastwards as dry Chinook winds. Along the coast these warm winds provide an equable climate with mild winters and abundant rainfall ; inland the extremes of temperature become far greater, with hot summers and cold winters. In the little-explored far north the winters are almost Arctic, because the Rockies are here too low to act as a barrier against the icy blasts from the interior plains and the Arctic coast.

It was the discovery of gold in 1858 that first led to the settlement of British Columbia. Although the province had perhaps been reached by Sir Francis Drake in 1578–79, and certainly by Spanish explorers in 1774 and Captain Cook in 1778, no efforts had been made to settle it by Great Britain, except for the trading posts of the enterprising Hudson's Bay Company. When it was part of the Company's territory, it was called New Caledonia.

A boundary controversy with the United States was settled by the Oregon Treaty in 1846. When the gold rush came, a more efficient government was needed, and British Columbia was made a Crown colony. For some years the province stood out against federation with the rest of Canada, but finally agreed in 1871 to join the Dominion on condition that a railway was built from coast to coast. This was the origin of the Canadian Pacific Railway, completed 1885, which, with the Canadian National Railway, brings to Vancouver large quantities of grain and lumber, thus making that city one of the most important ports in the world.

With an area of over 366,000 square miles and a population (1956 census) of 1,398,464, British Columbia is the third in size of the provinces of Canada.

A GREAT FAMILY *of* NATIONS

British Commonwealth. A writer on imperial matters is naturally tempted to seek parallels between the empires of ancient times and the vast British Empire, which has developed by slow stages into the British Commonwealth of Nations. But close examination shows that the differences are more noteworthy than the likenesses. The ancient empires grew by conquest, brought peace and prosperity (but often also slavery) to large areas for long or short periods, and then faded away, once the ruling power had become militarily weak and lost the will to control them. The British Empire, on the other hand, came into being first through the explorations of an indefatigable maritime people. But the nation that produced these superb sailors also produced large bodies of traders who were prepared to leave their homes, journey in tiny ships over enormous distances, and settle for life in far-off countries where the whole requirements of civilized existence had to be produced entirely by their own hard labour, ingenuity, and inventiveness. The seaways of the world are still the physical link that binds together this group of nations. Across them, day and night, plough thousands of ships, large and small, carrying raw materials to industrial lands and manufactured goods in the opposite direction.

But it is not only in its size and method of growth and maintenance that the community of British nations differs from the empires of antiquity. The very idea behind it is different. It exists not to enslave but to civilize and set free. Gradually, painfully, over a period of many years, there has grown up a system whereby the various parts of the group move step by step from being dominated or dependent units to the achievement of true and independent nationhood. The pace at which this process moves must naturally vary according to the educational, political, and commercial level reached by each community. But the fact that it exists at all is something unique in the world. Here is a commonwealth spread right across the earth, covering roughly a quarter of its surface and containing about a quarter of its population, kept together only by devotion to an idea.

The lands ruled by English kings in France from the Norman conquest to 1453 (with Calais remaining till 1558) were not colonies in any proper sense of the word. The English colonial expansion from which Empire and Commonwealth were to grow began after the discovery of the New World in 1492. Newfoundland first of all the colonies, was claimed in the Queen's name by Sir Humphrey Gilbert in 1583, but the claim was long disputed by the French. Not until the Treaty of Utrecht (1713) was it acknowledged as British.

Meanwhile during the 17th century groups of Englishmen with their wives, and often their children too, had founded colonies on the thinly-peopled eastern shores of North America, the first successful one being in Virginia in 1607. Usually these groups were refugees from religious persecution at home. For example, Puritans founded Massachusetts, Roman Catholics Maryland, Quakers Pennsylvania. Thirteen such colonies, from New Hampshire to Georgia, were founded and flourished, but after about a century they rebelled against George III and his ministers, who had tried to make them pay taxes without their consent. In 1783 Britain had to grant them independence, as the United States of America. (*See* AMERICAN INDEPENDENCE.)

Canada and Australia

British possessions farther north, in what is now Canada, remained loyal to the British Crown —including New France, the country around Quebec and Montreal, conquered by the British in 1760 and ceded by France in 1763. The inhabitants, who had been allowed to keep their own language, laws, customs, and religion, were content under their new rulers. Thousands of colonists who wished to remain under the British flag crossed from the Thirteen Colonies (i.e. the United States) into Nova Scotia, New Brunswick, and what is now Ontario. In 1791 the colonies of French-speaking Lower Canada (called Quebec from 1867) and English-speaking Upper Canada (called Ontario from 1867) were created. In 1837 rebellion broke out in both. The British government, wise after the loss of the Thirteen Colonies, sent out a commission under Lord Durham to consult with the people on the spot. In 1839 it recommended that the two colonies should be joined together and given self-government (with the government in London having final say in any doubtful matters). This advice was followed, and there began the building up of a kind of empire never known before. (*See* CANADA.)

On the other side of the world Australia, "the southern land," an island continent nearly 3,000,000 square miles in extent, was almost empty of human beings when Dampier visited the west coast in 1688. Captain James Cook sighted the east coast in 1770. It was less forbidding than the west, but no particular interest was taken in Australia until.

THE COMMONWEALTH OF NATIONS

Europe : U.K., Isle of Man, Channel Is., Gibraltar, Malta.

Asia : Ceylon, Republic of India, Republic of Pakistan, Federation of Malaya, Cyprus, Aden, Singapore and Christmas Island, N. Borneo, Sarawak, Brunei, Hong-Kong.

America : Canada, Bermuda, Bahamas, Barbados, Jamaica, Leeward Is., Trinidad and Tobago, Windward Is., Falkland Is., British Guiana, British Honduras.

Africa : Union of South Africa (with South-West Africa), Federation of Rhodesia and Nyasaland, Ghana, Basutoland, Bechuanaland, Swaziland, Kenya, Uganda, Tanganyika, Zanzibar, Somaliland, Gambia, Togoland, Sierra Leone, Nigeria, Cameroons, Mauritius, Seychelles, St. Helena, Ascension Island, Tristan da Cunha.

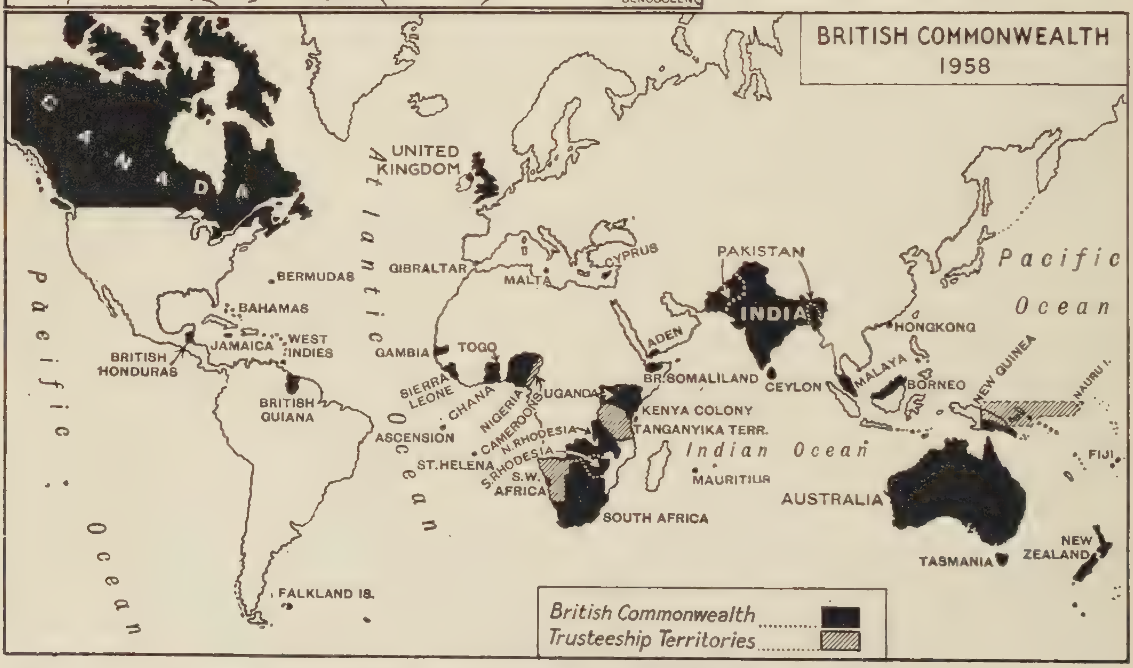
Australasia : Commonwealth of Australia, New Zealand, Papua and New Guinea, Norfolk Is., W. Samoa, Fiji, Solomon Is., Gilbert and Ellice Is., Tonga, Nauru, New Hebrides.

Antarctica : Ross Dependency (New Zealand) ; Australian Antarctic Territory ; Falkland Is. Dependencies.

after the revolt of the American colonies, it became necessary to find some other place to which to send convicts (who up to then had been transported to the American tobacco and sugar plantations). Captain Arthur Phillip was sent in 1788 to New South Wales (as Cook had named the land of his discovery) with a party of convicts and a small body of guards. He landed at what is now Sydney Cove, and founded a settlement that ultimately became the great city of Sydney. Until 1850 new arrivals in Australia were nearly all convicts—many of them, be it said, transported for what would now be considered quite trivial offences. Then the discovery of gold brought a rush of fortune-seekers. Many who had no luck in the goldfields became good settlers, taking up agricultural holdings, starting sheep farms, or mining Australia's other valuable minerals. (*See* AUSTRALIA.)

The first white men to visit New Zealand were whalers; and until 1840, when white settlement began, New Zealand was a dependency of Australia. But in that year it was given self-government.

India's story is different. With its teeming population and a climate disagreeable to white people, it was not attractive to European settlers. British interest there was at first entirely commercial, and began in 1612 with the setting-up at Surat, on the west coast, of a trading centre (called a factory) by the East India Company, chartered in 1600 by Queen Elizabeth I. (*See* INDIA.) It eventually secured control of large tracts of country, governing them on behalf of their princely rulers. At one time in the 18th century the French East India Company made a bid to drive out the British but was itself defeated and left with only a few small settlements covering less than 200 square miles. After the Indian Mutiny of 1857 the parts of India ruled by "John Company" (as it was called) were transferred to the British Crown, becoming a colony governed by British civil servants, assisted, like the Company's servants before them, by a volunteer army of Indian soldiers with British officers. The actual British troops stationed in this vast territory usually numbered about 80,000, mostly stationed in the north-west. In 1876 Queen Victoria was officially styled Empress of India, and the title of Emperor was thereafter retained by her successors until 1947. During those years British India was commonly called the Indian Empire. From 1885 onwards there was a growing Indian nationalist movement, increasingly hostile to British rule as the years went on.



THE BRITISH COMMONWEALTH'S AMAZING GROWTH

The British Commonwealth of Nations, a great and unique association of free peoples, is potentially a dominant force in world affairs. The smaller map shows the widest extent of British possessions in the 18th century, after Canada has been wrested from the French. But in 1783 the 13 North American colonies became independent, and any kind of British Empire, as it was then called, virtually ceased to exist. The large map shows the territories absorbed during the 19th century; and certain states that have achieved self-government and varying degrees of independence since 1900. Burma left the Commonwealth in 1947.

In South Africa white settlement also developed from trade. In 1652 the Dutch East India Company founded a port of call near the Cape of Good Hope where their ships could rest and re-victual on the long journey between the Netherlands and the East Indies. There were few black inhabitants there in those days, and the Dutch settlers began to spread into the surrounding countryside. When the French occupied the Netherlands in 1795, the British seized Cape Town, to prevent the French from occupying that too. It was returned to the Dutch in 1802, seized again in 1806, and in 1814 was bought from them for £6,000,000. It became the nucleus of Cape Colony, given its own responsible government in 1872. British and Cape Dutch settlement in Natal (given responsible government in 1893), Cape Dutch settlement in Transvaal and the Orange Free State (both conquered by Britain in the Boer War of 1899–1902, and given responsible government in 1907), were the beginnings of the other three provinces of South Africa (see article).

"Dominion Status"

Meanwhile in Canada the British North America Act of 1867 marked another and most important step in the evolution of this kind of empire. By it Upper and Lower Canada, Nova Scotia, and New Brunswick were federated to form the self-governing Dominion of Canada. Other provinces were added later, until Canada stretched from the Atlantic to the Pacific and from the Great Lakes to the Arctic Ocean. A similar status was given in 1900 (taking effect in 1901) to the Australian colonies, federated to become the Commonwealth of Australia; to New Zealand in 1907; and to the Union of South Africa in 1910.

When the First World War broke out in 1914, many people outside the British Empire were surprised that all the Dominions chose to support the Mother Country rather than break away. It was during this war, indeed, that General Jan Smuts (who had fought the British in the Boer War and had later become Prime Minister of the British dominion of the Union of South Africa) coined the happy phrase "British Commonwealth of Nations." Colonial political leaders had first met in London in 1887. Such meetings continued at intervals, and Imperial conferences in 1926 and 1930 laid down the principles upon which was founded the Statute of Westminster in 1931. This statute defined the Dominions of the British Commonwealth as "autonomous communities within the British Empire, equal in status, in no way subordinate to one another in any aspect of their domestic or external affairs, though united by a common allegiance to the Crown, and freely associated as members of the British Commonwealth of Nations." Henceforth this was the accepted name. It only remained for more and more of the colonies to achieve "dominion status."

Within a week of the outbreak of the Second World War in 1939—again to the amazement of many outside the Commonwealth—the Dominions, with the single exception of Eire (now the Republic of Ireland), had declared war at the side of the United Kingdom. And though Eire remained officially neutral, thousands out of her small population volunteered for the British armed forces.

After the Second World War came new problems for the Commonwealth to solve. Canada, Australia, New Zealand, and South Africa are governed by white people, a great number of whom are of British origin. An entirely new development occurred in 1947 with the granting of independence to British India, for its people differ in colour, blood, religion, and customs from the peoples of the other Dominions, The Muslim minority feared that they would be the victims of religious hostility from the vast Hindu majority; so that instead of a united India (for which Britain had hoped) the sub-continent was divided into two Dominions—India, predominantly Hindu, and Pakistan, mostly Muslim, and both remaining member-nations of the Commonwealth. In 1950 India decided to become a republic, thus abandoning that allegiance to the Crown which had been looked upon as the sole political bond between the Dominions. Yet so elastic is the Commonwealth that India, as she desired to remain a full member of it, was able to do so. India acknowledges not the symbol of the Crown but the person of the British sovereign as Head of the Commonwealth. Pakistan, presenting very much the same problem, became in 1956 the second republic within the Commonwealth, on the same terms as India.

Burma, conquered during the 19th century, was offered in 1947 the choice of dominion status or complete independence. She chose to become an independent republic, and so left the Commonwealth. Ceylon in the same year elected to become a Dominion. Eire, which had been given dominion status in 1922, left the Commonwealth and became the independent Republic of Ireland in 1949.

Crown Colonies and Protectorates

Within the British Commonwealth and under the rule of the colonial office in London, are Crown colonies, protectorates, and trusteeship territories. Most of them were originally of trading interest. British West Africa—Gambia, Sierra Leone, the Gold Coast and Togoland, Nigeria, and the Cameroons—is not suitable for white settlement because of its damp tropical climate, and has moreover a large black population. These Negro peoples are being helped to become self-governing, the Gold Coast (now Ghana) being the first to achieve full independence within the Commonwealth, in 1957. British East Africa—Kenya, Uganda, Tanganyika, and Zanzibar—has highlands where white people can live comfortably. Its black inhabitants are few compared with those of British West Africa; but because there are both black and white in considerable numbers, constitutional development is much more complicated. The same is true of Northern and Southern Rhodesia. These areas were acquired by the British South African Company (chartered in 1889) and ruled by it until the first became a protectorate in 1924, the second a self-governing colony in 1923. In 1953 both were merged in a new Federation of Rhodesia and Nyasaland.

Numerous islands, some large, some small, are scattered about the world—in the West Indies, in the South Atlantic, the Pacific, and the Indian Oceans—which have become British by conquest or settlement; and two areas on the American mainland—British Honduras, in Central America, and British Guiana, in South America. Many

have some measure of self-government, and all are being guided towards it.

The chief personages in this remarkable story are almost as varied in character, opinion, and achievement as the peoples that go to make up the Commonwealth. Explorers, sailors, soldiers, merchants, administrators are all woven into the tapestry—people like Cabot, Hudson, Raleigh, Drake, Clive, Warren Hastings, Livingstone, Gordon, and Rhodes spring to mind, and the stories of their lives may be read in other parts of this book. Lord Durham has already been named, and his work for the unification of Canada was of the highest significance. Most important, too, was the policy of " indirect rule " sponsored by Lord Lugard (1858–1945) in Uganda, allowing native institutions to be preserved side by side with Western administrative methods. Sir Stamford Raffles working in Singapore, the Brooke family in Sarawak, Lord Strathcona in Canada—so the tale goes on and the great idea takes shape. And often enough, work carried out in Great Britain itself—political, social, medical—has greatly contributed to development. For example, Sir Ronald Ross's achievement in discovering the cause of malaria has been of inestimable benefit to all dwellers in tropical lands.

So there has grown up a huge family of nations, comprising peoples of every colour and type, with the black and brown peoples (excluding India) outnumbering the whites by about six to one. There is every kind of religion, from Christianity and other great systems like Buddhism, Hinduism, and Islam, to voodoo and animism. Languages, too, cover most groups, from English and French to Chinese, Tamil, and Bantu. English naturally has a special position, and for India, with 147 tongues, it has been, in Ramsay Muir's words, " what Latin was to medieval Europe." It is spoken with very different accents by Canadians, Australians, and other whites, who have developed their own intonation and idiom alongside their individual ways of life.

Material and Moral Factors

Purely physical factors have played a large part in the evolution and survival of the Commonwealth. Command of the sea, skill and courage in navigation, have been vital. Railway development; the establishment of telegraphic networks ; air transport—all these have made their contribution. But over and above these material things there has been a set of ideas which constitutes a real and valuable contribution to civilization : deep sense of justice and respect for law ; love of personal freedom ; genius for compromise ; belief in parliamentary democracy. These intangible things have attracted the love and loyalty of millions.

The SHAPE *of the* BRITISH HOMELAND

British Isles. When you look at the map of Europe you see that the British Isles consist of a group of islands, lying off the north-west shores of western Europe, from which they are separated by the North Sea, the Strait of Dover, and the English Channel. England, Wales, and Scotland together form one larger island, bounded on the east by the North Sea, on the south by the English Channel, on the west by the Irish Sea and the Atlantic, and on the north by the Atlantic. Ireland is a separate island in the Atlantic. Besides these two islands there are some 5,000 smaller ones, ranging from sizable areas like Lewis to the minute islet of Rockall.

England, Wales, and Scotland and the adjacent small islands form Great Britain. The chief of these smaller islands are the Orkney and Shetland groups to the north and the Hebrides to the west of Scotland, the Isle of Man in the Irish Sea, the Scilly Isles to the south-west, the Isle of Wight and the Channel Islands to the south of England. In all, the British Isles cover an area of 121,633 square miles. Land's End and John o' Groat's are popularly named as the points farthest apart in Great Britain. Land's End is the most westerly point of the island, being about nine miles south-west of Penzance, in Cornwall ; John o' Groat's is on the north coast of Caithness, in Scotland. The distance between them is nearly 900 miles by road, and 600 miles as the crow flies.

The structural formation of the British Isles is a continuation of that of western Europe, to which, indeed, they were joined in ages long past. The British Isles stand on what is called the Continental Shelf, where the land slopes down from the mainland of Europe to the bed of the Atlantic Ocean. Consequently the seas between them and the Continent are nowhere more than 600 feet deep ; while on what may be called the outer side (that is, the side towards the Atlantic) the depth of the sea increases greatly in a short distance.

The position of the British Isles inevitably led in early days to various Continental contacts. To the north-east the islands of Scotland and Scandinavia formed stepping-stones for Scandinavian invaders, who left strong evidences of their presence in blood, language, and customs. The east coast, with estuaries such as the Humber, Wash, and Thames, faces that part of the Continent from which came Danes and their kindred Angles, Saxons, and Jutes. The south coast lies temptingly open to invaders from up the Channel or across it.

Now for a glance at the broad physical aspects of the British Isles. First, you may notice that the west coasts of Ireland and Scotland are much indented, and possess several fine natural harbours. Commercially, however, these are of no great value, except the Firth of Clyde, because nowhere does the land behind these harbours offer opportunities for industrial development. Very different are the great river estuaries such as Belfast Lough, the Clyde, Forth, Tees, Humber, Thames, Severn, and Mersey. These are of great economic advantage, as they not only bring the moderating influence of the sea to bear upon inland climatic conditions, but also allow sea traffic to approach comparatively close to inland centres.

If a line were drawn connecting the mouth of the Exe (at the town of Exmouth) with the mouth of the Tees (at Middlesbrough) it would cut Great

DOVEDALE, A LOVELY GLEN IN DERBYSHIRE

On the borders of Derbyshire and Staffordshire, Dovedale has been carved through the limestone hills by the river Dove. Cliffs, pasture, and woodlands combine to make it one of the loveliest parts of Derbyshire. Much of it has been presented to the National Trust for Places of Historic Interest or Natural Beauty, and will therefore remain unspoiled. This photograph is of a stretch on the east side of upper Dovedale. The whole valley is some $2\frac{3}{4}$ miles long.

Britain into two natural divisions—a highland region to the north and west of this line and a lowland area to the south and east. The highland region is formed of very old igneous or crystalline rocks, together with limestones, sandstones, and other rocks of considerable age geologically. Being generally very hard, these old rocks are not greatly affected by the erosive action of rain, ice, or the sea. Of the three upland regions—namely, the Scottish Highlands, the central highlands, and the southern highlands—the Scottish Highlands are separated by the Forth and Clyde from the central highlands, which extend south into the Midlands, and these in turn are separated from the southern highlands by the plain of southern Lancashire and Cheshire.

The Scottish Highlands are a well-marked region, surrounded on three sides by the sea and bounded on the south-east by a line drawn from the mouth of the Clyde to a point on the east coast some 20 miles south of Aberdeen. The west coast has sunk, and the sea has drowned the long narrow valleys, turning them into fjord-like sea lochs in a coast fringed with many islands. The interior is a land of heathery moors, above which rise heights of from 3,000 to 4,000 feet above sea level. Communication here is difficult, a fact which has led to the growth and preservation of strong clan feeling. Glenmore, the great glen extending from Fort William to Inverness, and containing three long narrow lakes joined by the Caledonian Canal, is an example of a fine natural highway wasted on a sparsely peopled country. Near its southern end is Ben Nevis (4,406 feet), the highest mountain in the British Isles. The greatest heights in the eastern highlands are to be found in the Grampians and the Cairngorms.

The central highlands comprise the uplands of southern Scotland, the Cheviots, the Pennines, and the hills of the Lake District, but the whole really forms a single natural region, in which communications are generally not easy, while the poor soil makes it unfit for anything beyond sheep farming, except where the discovery of mineral resources has made industrial development possible. The Tyne gap, traversed in the past by a Roman wall and to-day by the Newcastle-Carlisle railway, separates the Cheviots and Pennines. The Pennines extend south to the Trent valley, bordered on the west by the plain of Lancashire and Cheshire, and on the east by that of Yorkshire.

They are joined by Shap Fell to the hills of the

One of the wildest parts of the British Isles is the Black Mount (upper picture), a deer forest of the western Highlands. Beyond the peak of Coire Ba lies the vast Rannoch moor, some 400 square miles of heather and peat bog. The South Foreland (lower picture) is one of the chalk headlands on the coast of Kent, and is three miles north-east of Dover. This pleasant English scene contrasts vividly with the rugged mountain landscape of Scotland.

Lake District, which owe much of their beauty to former volcanic action. Thus the highest peak in England, Scafell Pike (3,210 feet), consists of volcanic ash compressed into very hard rock. The valleys with their lakes radiate from the centre like the spokes of a wheel. Direct railway communication between the Lancashire and Yorkshire industrial districts has necessitated much tunnelling through the Pennines.

The region of the southern highlands includes Wales, which is separated by the Bristol Channel from the hills of Devon and Cornwall. The Welsh highlands form a solid mass from north to south, nearly everywhere over 1,000 feet high, but deeply cut by rivers, in whose valleys, especially in the coal district of the south, the population has collected. Several of the rivers in Wales, such as the Dee, Severn, and Wye, rise near the west coast and flow east at the start of their course. Great Britain's longest river, the Severn, rises only 20 miles from the sea and flows north-east and east before turning south to the Bristol Channel. Snowdon, in the north-west, is the highest peak in Wales—3,560 feet.

South of the Bristol Channel is the south-western peninsula, consisting of Exmoor, Dartmoor, Bodmin Moor, and the Cornish hills. Between them are broad, fertile, well-cultivated valleys. The watershed is generally near the north coast, and the two chief rivers, the Tamar and the Exe, rise near the Bristol Channel but flow into the English Channel.

The isolated Mendip Hills, though lying just to the east of the imaginary Exe-Tees line, belong by their structure more to the region west of the line. They form the starting point, as it were, of the separation of industrial from agricultural England.

As for Ireland, the highland which nearly fills the north, west, and south of the island, almost surrounding the central lowland, is generally similar, in its original formation, to much of the highland of Great Britain, but it has been much more worn down by the action of water and ice. Instead of being in extensive blocks, as in Wales, the three highland regions of Ireland are broken up into smaller portions. A striking difference is presented by the mountains of Antrim, in the extreme north-east, which are of comparatively recent volcanic origin, the chalk or limestone being covered by black volcanic rock. The Giant's Causeway near Portrush, like the isle of Staffa off the west coast of Scotland, is formed of lava which has cooled into regular-shaped columns of basalt.

The foregoing is only a broad survey of the physical features of the British Isles. For details as to the topography, geology, climate, industries, communications, populations, etc., reference should be made to the separate articles on the four countries, and to such articles as GIANT'S CAUSEWAY; LAKE DISTRICT; PENNINES.

British Museum. During the lifetime of nations, as during that of individuals, objects of value and interest are collected and accumulated until the question arises: "How and where are all these precious and curious things to be kept and preserved?"

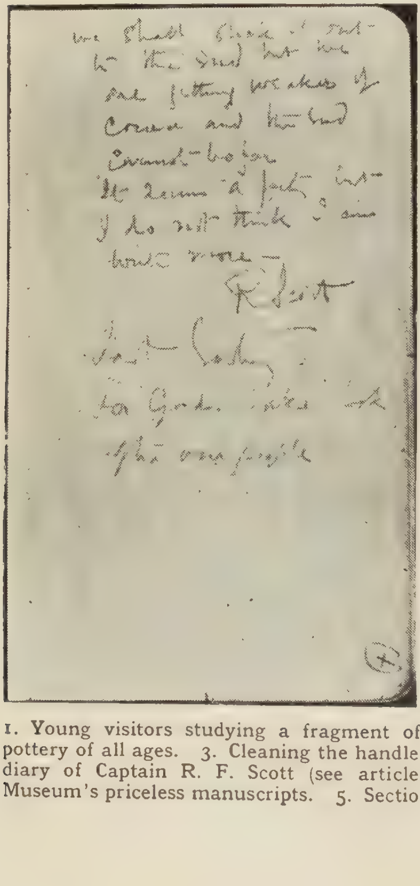
In the year 1753 the British government became concerned about providing a fit place for storing and exhibiting the nation's treasures, and the British Museum was created in London. The first home of the museum was Montagu House, a stately mansion which stood in about seven acres of grounds on the present site of the museum in Bloomsbury. This being acquired by the nation in 1754, the beginnings of the museum now housed there were furnished by a collection of books, curiosities, and objects of natural history which had been gathered together by Sir Hans Sloane and purchased by the government in 1753. Soon other great collections were added. Montagu House was opened in 1759. The house was demolished between 1828 and 1857 and larger buildings erected in its place. Several new galleries to the north of the old building were opened in 1914.

The British Museum is one of the richest treasure-houses in the world. And the public, who as taxpayers provide money for the care of these curious and precious things, may see them happily displayed while wandering round the galleries. The reading-room of the Library, which contains upwards of 5,000,000 volumes, is open to researchers, who must, however, apply in writing for a ticket. It would obviously be unfair to serious workers if the limited space was crowded out with "browsers." This library was started with a collection of manuscripts formed by Sir Robert Cotton, added to by his son, Sir Thomas, and presented to the nation by Sir John Cotton in 1700.

In the various exhibition galleries the visitor

SCIENCE AIDS THE BRITISH MUSEUM

Above is an interesting example of the work of the British Museum's research laboratory. On the left is a bronze ornament representing the Egyptian goddess Isis, badly disfigured by corrosion; on the right the ornament is seen after the corrosion has been removed by chemical processes. A speciality of the laboratory is the reconstruction of broken objects.


we shall stick it out
to the end but we
are getting weaker of
course and the end
cannot be far
It seems a pity but
I do not think I can
write more —
R. Scott
Last Entry —
For God's sake look
after our people

1. Young visitors studying a fragment of a colossal statue from ancient Egypt. 2. A gallery full of superb pottery of all ages. 3. Cleaning the handle of a Greek bronze mirror of the 5th century B.C. 4. Last entry in the diary of Captain R. F. Scott (see article), found with his body in frozen Antarctica, and now among the Museum's priceless manuscripts. 5. Section of a huge, ornamented stone balustrade from a Buddhist monument.

COLONNADED FAÇADE OF THE BRITISH MUSEUM

Situated in Bloomsbury, London, the British Museum originated in the purchase for the nation of Sir Hans Sloane's collections in 1753, and was established in Montagu House. Between 1828 and 1857 the museum was rebuilt. The colonnade was completed in 1852; and the circular reading-room, 106 feet high, was finished in 1857.

finds the story of civilization on the earth told, not in words, but in masterpieces of art. The sculptures include beautiful examples of the works of the Egyptians, Babylonians, Assyrians, Phoenicians, Greeks, and Romans. The Elgin marbles, from ancient Greece, are one of the world's most valuable museum collections.

The mummy cases from Egypt are of extraordinary interest; they contain not only mummies of human beings but also those of cats, calves, crocodiles, etc., as well as toys that were buried with the children to whom they belonged. The ancient Egyptians believed that the souls of the dead lived on as long as their bodies were preserved. To prevent the bodies from decaying, they practised an elaborate system of embalming, and after preparing the body they wrapped it in linen bandages until it was encased in many thicknesses. It was then placed in a decorated mummy-case, and closed up in a cave or an underground tomb. Some of the mummies in the British Museum are about 3,000 years old. (*See* EGYPT.)

The sculptures from the ancient cities of Assyria and Babylonia fill one with amazement. You may remember that the Bible tells how the kings of Babylon and Assyria often warred with the Jews and carried them into captivity. (*See* BABYLONIA AND ASSYRIA.)

Of great interest, too, are the written records of these great kingdoms. The Assyrian writers of 3,000 years ago did not write their histories on paper, but had their records stamped on tablets and cylinders of baked clay, so that they are as distinct to-day as when the imprints were made. In the Assyrian room one can see cylinders of Sennacherib, who is frequently mentioned in the Bible in the Second Book of Kings. There are tablets here on which are recorded the stories of the Creation and the Deluge, as the people of Assyria knew them. Close by, in one of the Egyptian rooms, there are wonderful books of another kind—namely, the papyrus books of the ancient Egyptians, written on long strips of a natural paper made from the papyrus plant and rolled up tight. It is wonderful that such books have been preserved, and can still be read, after lying buried for nearly 3,000 years.

In various other departments of the museum there are unique collections of vases, pottery, coins, and ornaments belonging to the ancient Greeks and Romans; implements and weapons of the Stone Age; Oriental arms and armour; Indian collections, and weapons and domestic articles of numerous savage peoples. In the King's Library there is a remarkable collection of postage stamps, as well as exhibits illustrating the history of printing and books. Elsewhere are displayed ancient and unique manuscripts in Greek and Latin, as well as documents illustrating the history of England, and many autographs and letters written by great Englishmen of the past. Here you can see the neat manuscript of one of Thomas Hardy's novels, or the last page of Captain Scott's diary (*see* SCOTT, R.F.). Then there is a magnificent collection of prints and drawings.

The British Museum library receives a free copy of every book, newspaper, and periodical printed in Great Britain. All the more important journals are preserved in files for the use of students. This collection became so enormous that in the year 1932 a new building (badly damaged during the Second World War, 1939–45) for the newspapers was opened at Colindale, near Hendon, Middlesex. During the First World War most of the smaller and more valuable objects were removed to the postal tube railway that runs from the General Post Office to Euston. In the Second World War places to which many valuable objects were removed included the Aldwych tube station in London, various country houses, and a disused quarry. The museum received several direct hits from bombs during the Second World War; on May 10, 1941, 10 galleries were wrecked, including the Greek vase room and Greek bronze room, and 150,000 books were lost.

In 1953 the museum celebrated its 200th birthday by a series of exhibitions. As the years have gone by, more and more care and attention have been given to the attractive display of the various exhibits; and the whole museum therefore looks much more bright and "modern" than it did.

Brittany, FRANCE. Wherever the flag of France flag waves over a fishing schooner, a merchant vessel, or a warship—whether it be on the Banks of Newfoundland in the North Atlantic, on the China coast, along the shores of Africa, or among the tiny islands of the Pacific—you will find the sons of Brittany, those black-haired, thick-shouldered sailors from the rock-bound peninsula which France thrusts westward into the Atlantic. For this former province (the French Bretagne) is inhabited by a seafaring people who for centuries have lived a life apart, gathering their living from the ocean or by cultivating the stony soil.

"The Breton peasant," say the French, "fears God and the sea, and naught else in the universe." Indeed, these descendants of an ancient Celtic people have clung far more closely than other Frenchmen to their old religious faith. Along the wayside one comes upon tall crucifixes, with men in long blouses and wooden shoes or women in quaint traditional costume kneeling before them.

The Bretons have their own language, akin to Welsh, and there are still many of them who cannot speak French. Welshmen and Bretons can understand one another's speech. Under the influence of industrial development old customs and costumes of Brittany are rapidly passing away. But one custom, the *pardon*, retains its popularity. It consists of a procession and service in church to the honour of a saint, either local or national, followed by merrymaking in the evening.

The biggest sea-ports of Brittany have become great naval stations or trade centres. Abundant crops are raised in the river valleys, especially in the north. Among important towns are the sea-ports of Brest and Nantes, and Rennes, the capital in the days when Brittany was a province.

In olden times this land was the home of the Armorican tribes, which came under Roman control about 51 B.C. Its people were akin to the Celts who then inhabited Britain, and the Romans gave to the peninsula the name of Britannia Minor, or Lesser Britain, to distinguish it from Britain. Through stormy generations it remained, most of the time, an independent duchy, until its duke become in 1547 King Henry II of France, and Brittany was united with the crown of France. At first supporting the French Revolution, it became strongly royalist after the murder of Louis XVI. In the 20th century the trend has been towards a moderate republicanism. The total area is 13,750 square miles, and the population in 1954 was 3,072,390.

Broadcasting. The various aspects of wireless broadcasting are fully treated in the articles RADIO, RADIO COMMUNICATION, TELEVISION, and VALVE.

Brontës, THE. In the Brontë Museum at Haworth, Yorkshire, among other little trinkets belonging to Charlotte Brontë, are her scissors, blunted at the points, because her gloomy father forbade pointed scissors in his house. How pathetically symbolic of the blunted youth of the three Brontë sisters, Charlotte (1816–55), Emily (1818–48), and Anne (1820–49), and their brother Patrick Branwell (1817–48)! Their father, the Reverend Patrick Brontë, was the incumbent of Haworth, near Keighley, from 1820 until his death in 1861.

BRETON FISHERMEN UNLOADING TUNNY AT CONCARNEAU

One of the numerous fishing ports of Britanny is Concarneau, on the east side of the bay of La Forêt. It is noted for its sardine, mackerel, and tunny fisheries, and for the lobster hatchery at the mouth of the harbour. The sea is in the blood of the men of Brittany, and in any vessel flying the French flag, it is safe to assume that many of the officers and men will be Bretons, just as most engineers in British ships are reputed to be Scotsmen, usually from the Clyde.

PARDON PROCESSION IN BRITTANY

The Bretons have their own language, akin to Welsh, and many customs which set them apart from the other inhabitants of France. Some customs are disappearing, but the *pardon* still retains its popularity. It consists of a procession and church service to the honour of a saint, followed by feasting and merrymaking in the evening.

His children were very small when he went to Haworth, and yet all four died before him.

Left motherless at an early age, they were brought up by a prim aunt and by a father who was as cold and dismal as the gravestones in his churchyard, in the cheerless parsonage of Haworth surrounded by bleak moors. An able man and a virtuous, conscientious parson, he was nevertheless totally unfitted to rear his delicate, sensitive, imaginative children. He wished to make them "hardy and indifferent to eating and dress." He certainly never made them hardy, for "endless tasks of sewing" seem to have been insisted on for the little girls, rather than vigorous play in the moorland air; while their dutiful indifference to eating doubtless contributed to their early deaths.

There are few tragedies in literature so full of pathos as the grey, monotonous, lonely lives of these three sisters, the fruitless hunger of their hearts for companionship and love, and their sad, untimely deaths. Two of the sisters, Emily and Anne, died within six months of each other, and their brother Branwell three months before Emily. Charlotte survived them until 1855, when she, too, died, nine months after her marriage (to A. B. Nicholls, her father's curate), which seems to have brought her the only real happiness she ever knew. She was only 39.

Charlotte Brontë, most famous of the sisters, became first a school teacher, then a governess, but these occupations were irksome and unsuitable, and she returned home. She spent a short time in Brussels, to improve her knowledge of languages. This glimpse of the greater world beyond her bleak moors powerfully influenced her life, and after her return to Haworth she wrote a number of letters to her old professor which are now historic. They furnish a graphic and touching story of her deeper thoughts and feelings, and her passionate heart-hunger for sympathy.

The sisters compiled and published, in 1846, a book of poems under the names of Currer, Ellis, and Acton Bell. They chose these names so that no one would be able to tell whether they were men or women. You will notice that each retained her own initials. Only two copies of this book were sold. They then turned their attention to

THE BRONTË SISTERS

"A family of geniuses" is a phrase that well describes the Brontës, for all three sisters gained literary fame, and their brother Branwell was no mean artist. This portrait of Anne, Emily, and Charlotte (right), in the National Portrait Gallery, London, is by Branwell.

RUPERT BROOKE

Poet and athlete, Rupert Brooke was one of many young men of great promise who lost their lives during the First World War (1914-18). This drawing by J. Havard Thomas is in the National Portrait Gallery, London.

fiction. Charlotte's earliest novel, *The Professor*, failed to find a publisher until after her death, but Emily succeeded with *Wuthering Heights*, and Anne with *Agnes Grey*. Charlotte then wrote another novel, *Jane Eyre* (1847), which won her universal fame. Later she wrote *Shirley* (1849) and *Villette* (1853). Emily, regarded by some as the greatest of the sisters, also wrote some deeply moving poems.

To-day the genius of the Brontës, especially of Charlotte and Emily, is acknowledged by all, and every scrap of their writings, even their exercise books, has been eagerly snapped up by collectors ; while the museum in the old parsonage at Haworth is visited every year by thousands.

Bronze. More than four thousand years ago a Stone Age man raked away the ashes of his fire and to his surprise found underneath them a heap of brownish metal. Quite accidentally, he had lit his fire over some copper and tin ore, and the heat had caused the two metals to melt together and form bronze.

Bronze was the first alloy (see article) made by man, and as it was found to be harder than copper or tin alone, it began to be used for making swords, axes, arrow-heads, and other weapons. Hence the period which followed the Stone Age has usually been called the Bronze Age, and in Europe it lasted from about 2000 to 1000 B.C.

Modern bronze consists of 96 per cent. copper and 4 per cent. tin, though these proportions are varied and other metals may be added when bronze is made for special purposes. Thus Admiralty gun-metal, originally used for making cannon, consists of 88 per cent. copper, 10 per cent. tin, and 2 per cent. zinc ; it is used for pump bodies and high-pressure steam plants. When two metal parts are revolving one inside the other, they have to be kept lubricated or oiled, but at very high speeds the oil tends to be squeezed away from the parts where it is most required. To overcome this trouble, engineers use leaded phosphor-bronze rings or bearings, like those in the propeller shaft of an aeroplane or ship. The phosphor makes the bronze very hard, while the lead acts as a sponge and holds the oil where it is most needed.

The addition of 7 per cent. of aluminium to bronze produces aluminium bronze, which is very hard and resists the corrosive (eating away) effect of acids. It is used for statues and for the decoration of the outsides of buildings, since it is not affected by exposure to the atmosphere. Aluminium bronze has a beautiful golden colour and is sometimes used instead of gold for making cigarette-cases and similar articles.

Bronze containing 94 per cent. copper and 6 per cent. tin is the best metal from which to make large bells (see article). This type of bronze has a rich tone when set vibrating by a sharp blow. Bronze consisting of 97 per cent. copper, 0·5 per cent. tin, and 2·5 per cent. zinc is used in Britain for minting pennies, halfpennies, and farthings (*see* MONEY). Until 1860 these coins were made from pure copper. That is why pennies are still called coppers.

Brooke, RUPERT CHAWNER (1887–1915). In 1914 England, alight with romantic patriotism, was deeply stirred by the war poems of a young naval officer who wrote gracefully and sincerely about his love for his country and his readiness to die fighting :

> If I should die, think only this of me :
> That there's some corner of a foreign field
> That is for ever England.

And when Rupert Brooke did, in fact, die of blood-poisoning while on active service at Scyros in 1915, he became almost a national hero. Later the glory faded, and other poets wrote bitterly of the waste and squalor of war. Brooke's sonnets of pride and honour were condemned as idealistic and untrue, and much of his early work was dismissed with the same rather unfair criticism. In fact, nobody knows what he would have written if he had shared the bitter experience of the others ; but he was always sincere and often humorous, and he wrote of an ideal world because he lived in one.

He was exceptionally good-looking and intelligent, and at Rugby School, where his father was a master, and at King's College, Cambridge, was a fine scholar and athlete. His first book of poems was published when he was only twenty-four, and two years later he travelled in America, Canada, Hawaii, Fiji, and New Zealand. With his charm, humour, and enthusiasm, he was the kind of person that most people would like to be, and he wrote chiefly the kind of things most people would like to feel. So his early poems, full of intense appreciation of life and beauty, are still popular, especially "The Great Lover" and "The Old Vicarage, Grantchester", with its whimsical ending :

> Stands the Church clock at ten to three ?
> And is there honey still for tea ?

At the same time, some of his love poems are very bitter, and this "romantic" young man is probably the only poet who has ever written a really truthful sonnet about love and sea-sickness.

Brown, JOHN (1800–59). A soldiers' song, a memorial to a strange, fanatical man whose fight against the slavery of Negroes cost him his life and hastened the outbreak of the American

Civil War, is known all over the English-speaking world. Its first verse runs :

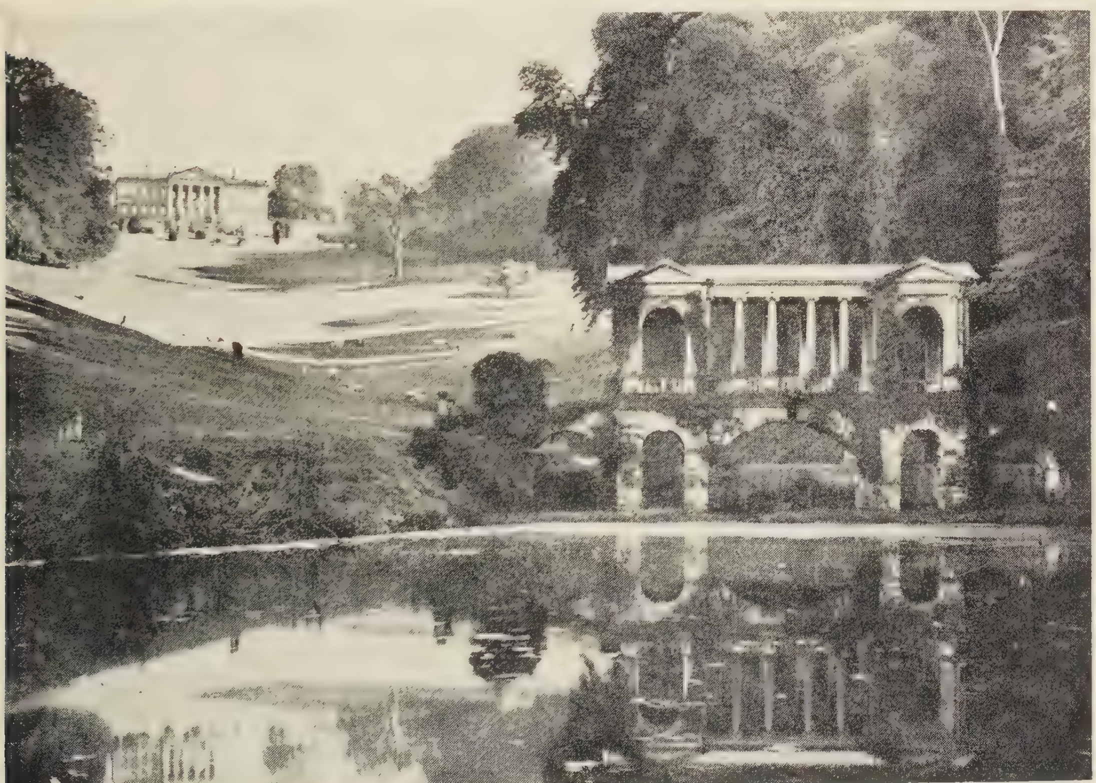
> John Brown's body lies a-mouldering in the grave,
> But his soul goes marching on.

John Brown was a wool dealer, born at Torrington, Connecticut, and descended from a Puritan carpenter who had emigrated in the *Mayflower*. All his life he hated slavery, and he brought up his children to fight it as fiercely as he did himself. In 1854 the problem was being disputed in local elections in the state of Kansas, so Brown and his sons went to live there and took part in the speeches and skirmishes. One of his sons was killed in a fight, which increased his bitterness. Two years later, in a famous battle at Osawatomie, with only 15 men, he held off 500 pro-slavery men from Missouri, and won the nickname of "Osawatomie Brown," as well as additional support.

When Kansas finally voted against slavery, Brown and his sons travelled north and east, denouncing and attacking its supporters. In 1859, with the object of stirring Southern slaves to rebellion, he collected 17 white men and five Negroes at a farm in Hagerstown, Maryland, and on the night of October 16, raided the town of Harper's Ferry, capturing its store of weapons and ammunition and about 50 prisoners. But he was soon surrounded by 1,500 militiamen, and in the attack that followed two of Brown's sons were killed as well as eight of his friends. Seven were taken prisoner ; the other five escaped. Brown himself was captured, badly wounded. He was tried for "treason, conspiring with slaves and other rebels, and murder in the first degree," and hanged on December 2. His execution inflamed that bitterness between supporters and opponents of slavery which eventually flared into war : and in 1861 the anti-slavery Union men marched to battle chanting the song inspired by the man who had died on the scaffold two years before.

Brown, LANCELOT (1715–83). A gardener's boy who became famous as a landscape gardener, Lancelot Brown was born in 1715 in the tiny Northumberland village of Kirkharle. At the age of 16 he went to work in the gardens on the estate of Sir William Loraine, and there he began to learn the art which later became his life-work. When he was 23 he decided to move south, and went to Buckinghamshire, where in 1740 he started work in the gardens of Lord Cobham's mansion at Stowe. The grounds there were world-famous, and visitors came from every country to admire them, so, with the encouragement of Lord Cobham, Brown studied the subject of landscape design and experimented in the gardens of his patron, often advising Lord Cobham's friends if they needed assistance in laying out their estates.

When his patron died, Brown was 33 years old and he decided to begin to practise as a landscape designer. In 1751 he moved near London and



ESTATE LAID OUT BY "CAPABILITY" BROWN

Born in 1715, Brown became a gardener at Stowe House, Buckinghamshire, where he displayed remarkable ability in planning gardens to give the full effects of the natural landscape. He laid out gardens and parks at many of the finest country mansions in England, including Prior Park, Bath (above), and Blenheim Palace, Oxfordshire.

ELIZABETH BARRETT BROWNING

Though an invalid most of her life, Elizabeth Barrett charmed Browning with her gaiety, sympathy and finely sensitive mind, and they were secretly married in 1846. They went to Italy, where they lived in great happiness until her death in 1861. This portrait by M. Gordigiani is now in the National Portrait Gallery, London.

lived at Hammersmith, taking an interest not only in the design of gardens but also in the ornamental buildings that were often required in them, and finally in the design of country houses. In 1764 the King appointed him Surveyor to H.M. Gardens and Waters at Hampton Court. By this time his fame as a landscape designer had spread and he was carrying out work for all the landed gentry of the country. He earned for himself the nickname of "Capability" Brown by his habit of saying that the grounds he had to lay out had "capabilities." To-day his work can be seen in many of the great country houses and palaces of England, like Blenheim Palace and Chatsworth House. He was also the designer of a number of smaller country houses. He died in 1783 at the age of 67.

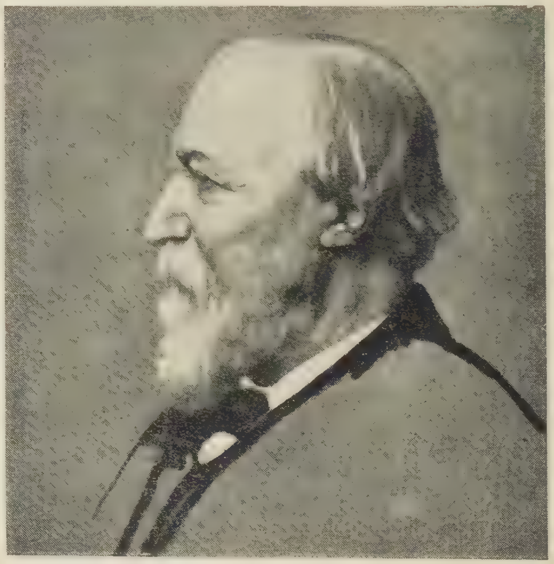
The work of Capability Brown brought new life to English landscape design, for before his time country house gardens had been mostly formal affairs with rigid patterned layouts, and an almost unnatural air about them. Brown developed the natural landscape. His carefully-arranged trees, water, and parkland produced charming scenes such as distinguish the great English parks to-day. He had wide influence and many followers.

Browning, Elizabeth Barrett (1806–61). This gifted poet was such a precocious child and lover of verse that she read Homer in the original Greek at an early age, and composed an epic poem on the Battle of Marathon at the age of 13. She was an invalid most of her life, following a riding accident when she was 15. Robert Browning called her "a soul of fire in a shell of pearl." A literary correspondence had led to their first meeting in 1845, when Miss Moulton Barrett (as she was then) immediately charmed Browning with her gaiety, sympathy, and sincerity. Browning's visits had to be concealed from her father, an eccentric and selfish man who forbade any of his children to think of marriage. In 1846 she left his gloomy house in Wimpole Street, London, to marry Browning in secret and go away with him to Italy. There they lived until her death. The city of Florence marked with a tablet the house in which she had lived, in gratitude for her sympathy with the Italian struggle for liberty. Among her best-known writings are "Sonnets from the Portuguese" (in fact, her own original work), in which she pours out her love for her poet husband-to-be; "Casa Guidi Windows," dealing with the Italian patriotic struggle of 1848–49; "Aurora Leigh," a romantic narrative poem, which resembles a novel in verse; and "The Cry of the Children," a fine emotional lyric that helped to rescue children from labour in factories and mines.

Here is one verse:

"For oh," say the children, "we are weary,
  And we cannot run or leap;
If we cared for any meadows, it were merely
  To drop down in them and sleep.
Our knees tremble sorely in the stooping,
  We fall upon our faces, trying to go;
And, underneath our heavy eyelids drooping,
  The reddest flower would look as pale as snow.
For, all day, we drag our burden tiring
  Through the coal-dark, underground;
Or, all day, we drive the wheels of iron
  In the factories, round and round."

Browning, Robert (1812–89). No poet was ever more intensely alive and human than Robert Browning, nor felt more keenly the joy of life and living. His life was happily free from poverty. His father, a man of strong literary and artistic tastes, encouraged the boy in his love of



ROBERT BROWNING

This fine head of the famous Victorian poet was painted by Professor Alphonse Legros (1837-1911) in 1888, a year before Browning's death, and belongs to the Victoria and Albert Museum, South Kensington, London.

books and art and music. Given the run of his father's great library in his boyhood home at Camberwell, London, he read not only Byron and Shelley and Keats but also many books far beyond his years. By the time he was 12 he had completed a volume of poems. His first published poem, "Pauline," appeared when he was 21.

His meeting with Elizabeth Barrett was the beginning of one of the most beautiful romances in literary history. After their marriage in 1846 they went to Italy, and lived an ideally happy life there until Mrs. Browning died in 1861. Bearing his loss with steadfast courage, Browning turned to writing with even greater energy. Most of his time was now spent in England; but he died in Venice, not long after penning the lines which might well be a description of himself:

One who never turned his back, but marched breast forward,
  Never doubted clouds would break,
Never dreamed, though right were worsted, wrong would triumph,
Held we fall or rise, are baffled to fight better,
  Sleep to wake.

His body was brought to England and buried in the Poets' Corner, Westminster Abbey.

Much has been said about the difficulty of reading Browning's work. Certainly his themes were often unusual and sometimes eccentric, and his verses were so packed with thoughts that he was not always so careful as he might have been about their form and thereby lost clarity.

The most difficult to understand of all his works is "Sordello," of which Tennyson said that there were only two lines which were clear to him, the first, "Who will may hear Sordello's story told," and the last, "Who would has heard Sordello's story told"—and these, he jokingly added, were both lies. On the other hand, no one pretends to find any difficulty in the delightful "Pied Piper of Hamelin," the rollicking "Cavalier Tunes," such stirring ballads as "Hervé Riel" and "How They Brought the Good News from Ghent to Aix," and the lyrical "Home-thoughts, from Abroad" (which we print below). Among poems which carry a deeper message, and which thoughtful people will appreciate and love more and more as they grow older, are "Pippa Passes," "The Boy and the Angel," "Evelyn Hope," "My Star," "One Word More," "The Lost Leader," "Saul," "Rabbi Ben Ezra," and "Prospice."

Browning's longest and, as many think, his greatest work is "The Ring and the Book." This poem, suggested by an old parchment-covered book which he picked up in Florence, tells the story of a murder from twelve different points of view. It shows Browning's wonderful ability to reveal character from within and to see through the eyes of others. This power would have made Browning a great dramatist had he not been too much concerned with the inner workings of the mind and too little with outward acts. Some of his dramas, however, such as *A Blot in the 'Scutcheon* and *Strafford*, are well worth reading.

Home-Thoughts from Abroad

BY ROBERT BROWNING

O to be in England
  Now that April's there,
And whoever wakes in England
Sees, some morning, unaware,
That the lowest boughs and the brushwood sheaf
Round the elm-tree bole are in tiny leaf,
While the chaffinch sings on the orchard bough
In England—now!

And after April, when May follows,
And the whitethroat builds, and all the swallows!
Hark, where my blossom'd pear-tree in the hedge
Leans to the field and scatters on the clover
Blossoms and dewdrops—at the bent spray's edge—
That's the wise thrush; he sings each song twice over,
Lest you should think he never could recapture
The first fine careless rapture!
And though the fields look rough with hoary dew,
All will be gay when noontide wakes anew
The buttercups, the little children's dower
—Far brighter than this gaudy melon-flower!

Bruce, Robert, King of Scotland (1274–1329). A famous Scottish legend tells that in the year 1306, in a wild district of the west, a fugitive and discouraged king lay on a bed of straw, watching a spider hang from its web and try to swing from one beam to another of the wretched cottage roof. Six times the spider failed. "If it tries again and succeeds," said the watcher to himself, "I will make another attempt to regain my throne." At the seventh try the spider succeeded.

Robert Bruce was the king's name, and it is not very likely that his resolution ever depended on that of a spider. He belonged to a Norman family possessed of lands in both England and Scotland. When he was 16, his grandfather, also named Robert, was among twelve claimants to the throne of Scotland, left vacant by the death in 1290 of King Alexander III's grandchild and successor, Margaret (called the Maid of Norway, because her mother had been queen of that country). King Edward I of England was asked to decide the Scottish succession; he awarded the crown to John Baliol, a cousin of the Bruce, on condition that Baliol became his, Edward's, vassal.

Baliol soon found his position difficult; he rebelled and was deposed and imprisoned. Bruce earned Edward's displeasure by stabbing another leading Scots baron, John Comyn, in the Grey Friars' Church at Dumfries while the English king's justices were holding an assize in the town. Bruce took to the hills and became the leader of a new rebellion. In 1306 he was crowned king of Scotland at Scone, but was again forced into hiding; to this period, if any, belongs the story of the spider.

National Gallery, London

PIETER BRUEGHEL'S "ADORATION OF THE KINGS"

Among the best-known works of Pieter Brueghel the Elder is his "Adoration of the Kings," which can be seen in the National Gallery, London. His paintings are strong and clear in design, and even when his subjects are of a religious kind, he contrives to introduce an odd or amusing touch, such as the man wearing horn-rimmed spectacles, seen on the extreme right in this picture.

In 1307 Edward I died on his way to Scotland, and his feeble successor, Edward II, did nothing for some time to prevent Bruce from retaking one by one the Scottish castles held by the English. In 1314, however, Edward marched a large army across the Border; Bruce completely defeated it at Bannockburn. Scottish independence was secured, and "Good King Robert" went on to reign for another fifteen years. He wanted to go on crusade to expiate the murder of Comyn, but was never able to leave the country. In later life he became a leper. When he was dying he told his friend Sir James Douglas to have his heart removed after death and to take it to Palestine.

In due course the faithful Douglas set out for the Holy Land with the heart in a silver casket. In Spain he helped to fight against the Moors who held much of the country. Finding himself hard pressed in a battle, he threw the casketed heart amid the enemy, shouting: "Go thou before as thou wert wont to do, and Douglas will follow!" Then he charged after it and fell gloriously, but his doughty companion-in-arms Sir William Keith recovered the casket, and the heart of Robert Bruce was buried in Melrose Abbey.

Brueghel, Pieter (died 1569). The name of this interesting old Flemish painter is sometimes spelt Breughel, and is usually pronounced as though it were spelt Broy-gel. He was born

near Bruges, studied painting in Antwerp, and eventually settled in Brussels. The pictures he best enjoyed painting, and for which he is still most admired to-day, were gay, amusing scenes of peasant life, such as village dances and feasts. He liked to fill his canvases with lots of men, women, and children, mostly with quaint, homely faces, some with odd clothes, all very much alive. Even when he painted religious pictures he was always more concerned with oddities of face or costume than with the dignity of his subject, as anyone will realize who studies his "Adoration of the Kings" in the National Gallery, London—in which one of the figures wears horn-rimmed spectacles! What attracts many people to-day about his work is the fact that his pictures—whatever their subjects—are strong and clear in design and make pleasing patterns of bright colour. Every generation seems to look for something different from its works of art, and the present generation looks with special favour upon pictures with these qualities; so the works of Brueghel are more universally popular to-day than they ever were, even in his lifetime.

BRUGES, AN OLD FLEMISH TOWN

About eight miles from the North Sea, the Belgian town of Bruges is intersected by many canals, which connect it with Zeebrugge (its seaport), Ostend, and many other places. Crossing these are some 50 bridges, and the city's Flemish name is Brugge, meaning bridge.

He had two sons who also became well-known painters. One was called Pieter, too, but to distinguish him from his father, people spoke of him as "Hell" Brueghel because he was so fond of painting devils. The other son, Jan, was nicknamed "Velvet" Brueghel; he excelled in landscape painting, and the great painter Rubens sometimes employed him to add landscape backgrounds to his own pictures.

Bruges, Belgium (pron. brōōzh). One of the most justly famous of the old Flemish towns is Bruges, 62 miles north-west of Brussels and about eight miles from the North Sea. It is intersected by many canals, which connect it with Zeebrugge (its seaport), Ostend, and many other places. Crossing these canals are about 50 bridges. The city gets its Flemish name of Brugge (bridge) from the first bridge built over the Reye about 860. In the Middle Ages the city was one of the wealthiest in Europe, thanks to the wool trade, and to-day tourists travel far to admire its buildings.

The chief of these is the *halles*, or market hall, with the famous belfry 220 feet high and a peal of 47 bells. Another fine building is the *hôtel de ville* or town hall, and near it is the chapel of the Holy Blood. Two of the old guild-houses still stand, and the weighing house is noteworthy. Three massive gates remain of the fortifications.

The chief church is St. Saviour's, the cathedral, in which may still be seen the armorial bearings of 29 knights who attended a meeting of the Order of the Golden Fleece in 1478. In the church of Notre Dame are the tombs of the great Duke of Burgundy, Charles the Bold, and his daughter Mary. In the hospital of St. Jean is the shrine of St. Ursula, and near it is the 12th-century *Béguinage* (nunnery), still so used. The Palais de Justice is on the site of the residence of the old Counts of Flanders.

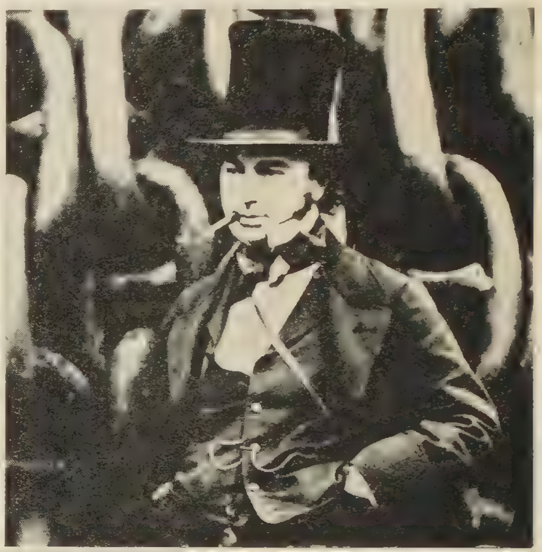
In the 12th and 13th centuries Bruges was one of the richest possessions of the Counts of Flanders, and in 1430 Philip the Good, Duke of Burgundy, founded the Order of the Golden Fleece there as a tribute to its woollen industry. With the silting-up of the Zwijn estuary in the 15th century, the trade of Bruges lessened. New docks connected by a ship canal with the sea at Zeebrugge (Bruges by the Sea) were built at the end of the 19th century, and did much to restore prosperity to the town. In the summer of 1914 the Germans, as they swept across Belgium, in the First World War, occupied Bruges. Zeebrugge became an important German submarine base, and there on April 23, 1918, occurred a successful British naval raid, in which three old cruisers filled with cement were sunk in the channel leading to the harbour and "bottled up" the German submarines. In the Second World War, German troops occupied Bruges on May 29, 1940. On September 12, 1944, the 1st Canadian Army liberated it almost without damage to its buildings. The estimated population in 1954 was 51,650.

Brunel. Sir Marc Isambard Brunel (1769-1849) and his son Isambard Kingdom Brunel (1806–59) both rose to fame in the engineering profession. Each was notable for daring and successful enterprises in both civil and mechanical engineering; each helped the other.

Marc Brunel was the son of a Norman landowner. He served for six years in the French navy; but, being a royalist, he left it in 1793 and emigrated to New York. There he worked on the design of machinery, and invented a method of mass production of wooden pulley-blocks for use on ships. In 1799 he came to England, and finally sold his invention to the Admiralty for £17,000. A series of machine-tools were set up, each carrying out one operation—a forerunner of modern methods. He designed many fixed and swing bridges, and the first floating landing-stage—at Liverpool. He invented a great number of machines, including a knitting-machine and an early sewing-machine; but his greatest achievement was the Rotherhithe tunnel under the Thames. This had to pass through water-bearing ground; but by studying the operations of the teredo or "shipworm" he invented a shield which could be pushed forward through the soil, keeping out the water and allowing the soil to be excavated safely. The tunnel was started in 1825, and completed in 1843. He was knighted in 1841.

His son Isambard, after three years at the Henri IV School in Paris, became assistant to his father at the age of 17. He was resident engineer on the Rotherhithe tunnel, 1825–28, and displayed great skill and courage when it was flooded. In 1833, when only 27, he was appointed engineer to the Great Western Railway, which he built to a gauge of 7 feet—altered in 1892 in one night to the standard gauge of 4 feet 8½ inches. Among other bridges, he built the Saltash bridge of two 455-foot spans—one of the earliest truss bridges—which still carries the railway over the Tamar. He built Hungerford and Clifton suspension bridges (the first removed in 1862 to make way for Charing Cross railway bridge), and did much of the construction at Plymouth and Milford Haven Harbours. He designed the *Great Western*, the first steamship specially built for the Atlantic trip. She made her maiden voyage in 1838. This was followed in 1845 by the *Great Britain*, the first screw steamer to cross the Atlantic, and in 1858 by the *Great Eastern*, for many years the largest in the world. He also built a hospital in the Dardanelles during the Crimean war.

Brussels, Belgium. The Belgian capital is esteemed to be one of the most beautiful and charming of European cities. It is a centre of art and fashion, of industry and commerce, a modern, well-kept city with many fine new buildings and



BRUNEL AND THE "LEVIATHAN" OF HIS DESIGN

Isambard Kingdom Brunel, British engineer, is seen in the photograph at the top. The lower picture shows one of the most celebrated products of his genius—the *Great Eastern*, propelled by paddle-wheels and a screw propeller. This vessel, first named the *Leviathan* because of its great size, was also equipped with sails. Length was 692 feet (compare with the *Queen Elizabeth's* length of 1,031 feet) and her gross tonnage 18,915 (*Queen Elizabeth* 83,673 tons).

other public improvements, yet with a few quaint and picturesque remains of bygone days. With its boulevards, parks, and squares, Brussels has justly been called "Petit Paris."

Brussels is situated in the middle of Belgium, about 50 miles inland from the North Sea. Unlike many European capitals, that of Belgium stands on no great river, but on a tributary of the Scheldt called the Senne. Nevertheless its trade has been promoted by a network of canals and railways that connect it with Antwerp, other Belgian cities, and the North Sea. In addition two streams of international railway traffic cross here—from France to the Netherlands and from Ostend to Central Europe. Airliners fly regularly between Brussels and all parts of Europe, the U.S.A., Canada, the Middle East, and the Belgian Congo.

The old walls were replaced by boulevards in the 1830s. The monuments and art treasures of Brussels are priceless. Theatres and cinemas abound, and opera at the Théâtre de la Monnaie is excellent.

Belgian National Tourist Office

BRUSSELS TOWN HALL ON THE GRAND PLACE

A building of great interest, the town hall, or *hôtel de ville* is almost entirely of the 15th century, and possesses a most unusual feature in the soaring spire (370 feet high), which is surmounted by a gilded figure of St. Michael, the original patron saint of Brussels. The Grand Place itself has many historical associations.

The interesting Grand Place, or market-place, is surrounded by many fine old buildings in strong contrast to the otherwise modern character of the city. The largest and most beautiful of these is the 15th-century Gothic *hôtel de ville*, or town hall. Its belfry, 370 feet high, is crowned with a gilded statue of St. Michael, the city's patron saint. Its treasures are its archives, tapestries, and pictures. Nearly opposite the town hall is the 16th-century Maison du Roi. It was never a royal residence, and, now used for municipal purposes, is popularly called the Broodhuis (Bread House).

This square, the Grand Place, is in the lower city, now devoted mainly to manufacture and commerce. The upper city contains the public buildings and the mansions of the wealthy. Overlooking the lower part of the city is the 13th-century church of Saint Gudule and Saint Michael, with pointed Gothic towers and rich stained-glass windows. Among other ancient buildings of note in Brussels is the 14th-century church of Notre Dame du Sablon, also called Notre Dame des Victoires, founded by the Guild of Crossbowmen. The royal library, the museums, and the art galleries contain priceless treasures, including wonderful examples of Flemish painting by the brothers van Eyck, Roger van der Weyden, Hans Memlinc, Quentin Matsys, Rubens, Van Dyck, and many other famous old masters.

Among modern buildings are the king's palace, the houses of parliament, and the magnificent Palais de Justice (law courts, completed in 1883). The park between the royal palace and the houses of parliament were the centre of the fighting in 1830 (*see* Belgium). The university, founded in 1834, is the most important of the city's many educational institutions, and is notable as almost the only university in Europe founded without the help of Church or state.

Brussels (Bruxelles in French, and Brussel in Flemish) was traditionally founded in the 6th century, and received its name (*broek sele*, the dwelling on the marsh) from the nature of the

ST. GUDULE'S CHURCH, BRUSSELS

Considered to be one of the most imposing buildings in Europe, the church of St. Gudule is a specimen of pure Gothic architecture, parts dating from the 13th century. A feature of the church is its stained-glass windows.

site. Its growth was slow until the days of the Burgundian dukes in the 15th century, when it became one of the important cities in the Netherlands. It was prominent in the rising against Spain (1566), but remained under Spanish rule after the northern Netherlands had made good their independence. Much damage was done when the town was bombarded by the French general Villeroi in 1695. It passed to Austria in 1713, following the War of the Spanish Succession. After a brief period of French rule during the French Revolution and the First Empire, it was, with other parts of Belgium, incorporated with Holland in the Kingdom of the Netherlands. In 1830 Brussels was the chief centre of a revolt which separated Belgium from the Netherlands, and it became the capital of the Belgian kingdom when that state was recognized in 1839.

In the First World War the Germans entered Brussels on August 20, 1914, and remained there until the Armistice in November 1918. During the occupation Burgomaster Max (1869–1939) led the people in their resistance to the Germans. It was at Brussels that Edith Cavell, British nurse, was shot in 1915. The city was again taken by the Germans in the Second World War on May 17, 1940, and suffered occupation until liberated by British troops on September 3, 1944. Except for the burning of part of the Palais de Justice, the Germans did not damage the city, but a certain amount of damage was caused by flying bombs and rockets during the winter of 1944–45.

The famous Brussels lace, as well as carpets, furniture, and cotton and woollen print fabrics are made. Printing is carried on, and there are sugar refineries, foundries of iron and brass, and engineering works. The vegetables called Brussels sprouts may have originated near by, as records show that they were sold in the 13th century.

The estimated population of Brussels in 1954 was 976,443. Both French and Flemish are spoken, French being predominant in the upper city and Flemish in the lower city.

Brutus, Lucius Junius. A famous figure from the early history of Rome is Lucius Junius Brutus, regarded as a model of Roman justice. It is difficult to disentangle history from legend in his story, but he is held to have become, in 509 B.C., one of the first consuls of the republic of Rome, after the overthrow of the royal house of Tarquin. The Tarquins had angered the people by their treatment of the best servants of the state. In particular, Sextus Tarquinius shamefully treated Lucretia, wife of Collatinus. Brutus then headed a successful movement to overthrow the ruler and set up a republic of which he and Collatinus became the first joint consuls.

For a long time the country was involved in strife, the royalists being determined to destroy the republic. Stern measures were needed, and Brutus gave orders for the rebels to be rounded up and brought to trial. He and Collatinus presided at the trial ; and when the rebels were brought in, it was discovered that the two sons of Brutus were among them. The people were filled with excitement ; how would Brutus act towards his sons, bound as felons and traitors before him ?

Bred in the Roman tradition, Brutus set aside all personal feelings and, outwardly calm, proceeded with the trial. When the guilt of his sons was proved beyond doubt, he sternly condemned them to death with the other prisoners and himself supervised the execution. This was in accordance with the highest tradition of Rome, that justice must be done at all costs. A later rising led to the death of Brutus and Aruns Tarquinius.

Brutus, Marcus Junius (85–42 B.C.). Known to history as the slayer of Julius Caesar, Marcus Junius Brutus was orphaned at the age of eight, through the murder of his father by Pompey. None the less he gave support to Pompey (49 B.C.) on the outbreak of civil war, and fought against Caesar. After the battle of Pharsalus, which gave the victory to Caesar, Brutus was not only pardoned by Caesar but was also given the greatest marks of confidence and favour. In 46 B.C. Caesar made him governor of Cisalpine Gaul, the northern part of Italy, which lies south of the Alps. Two years later Caesar made Brutus praetor, a magistrate elected annually at Rome. Even so, Brutus could not forget the early training given him by his uncle, the younger Cato, and in spite of Caesar's kindness to him he still obeyed the call of those who would re-establish the republic against what was called Caesar's imperialist tyranny.

Although living on terms of the most intimate friendship with Caesar, Brutus allowed himself to be drawn into the conspiracy against Caesar's life. Julius Caesar had now become so powerful that only his death, it was thought, could give the

conspirators a chance to restore the republic. Cassius was the chief conspirator, but Brutus had the task of stabbing Caesar. As the dagger went home, Caesar is said to have murmured "*Et tu, Brute*" (You also, Brutus ?). After Caesar's death Brutus and Cassius led the army which opposed Antony and Octavian at Philippi, 42 B.C. When his troops were defeated Brutus committed suicide by falling upon his sword, held firm by a reluctant friend. Shakespeare makes Antony speak over him a moving farewell :

> This was the noblest Roman of them all ;
> All the conspirators save only he
> Did that they did in envy of great Caesar ;
> He only, in a general honest thought
> And common good to all, made one of them.
> His life was gentle, and the elements
> So mix'd in him that Nature might stand up
> And say to all the world, "This was a man !"

Bucephalus (pron. būsef'*alus*). Perhaps the most famous horse in history is Bucephalus, the charger of Alexander the Great (see article). According to Plutarch, this animal was offered to Alexander's father, Philip of Macedon. But it was so wild that it appeared unmanageable and Philip ordered it to be sent back to the seller. Alexander was standing by, and noticed that the horse shied at its own shadow ; he turned its head towards the sun, caressing and soothing it meanwhile. After a time he mounted, and rode the horse until he had mastered it, whereupon Philip paid the seller thirteen talents (a cheap price in those early days). When Alexander dismounted, his father embraced him and said : "My son, you must indeed have a realm that is your due, Macedon itself is not big enough to hold you !"

Bucephalus carried Alexander through all his campaigns, and horse and rider came to be as one. The horse died in the Punjab, in India, at the great age of 30. Alexander was so distressed that he built a city over its resting-place and called the place Bucephela. The modern city on the same spot is Jhelum, on the river Jhelum (ancient Hydaspes), a tributary of the Indus, in Pakistan.

MARCUS JUNIUS BRUTUS

This is the famous Brutus who, like his less well-known forefather, L. Junius Brutus, sacrificed much for the republic, for he helped to kill Julius Caesar, his friend, in order to save Rome from dictatorship.

Buchan, JOHN, 1ST BARON TWEEDSMUIR (1875–1940) (pron. buk'*an*). A fine romancer, whose novels are known and loved wherever English is spoken, John Buchan crowded so much varied activity into his life that one wonders when he found time to sleep. Lawyer, journalist, novelist, historian, biographer, publisher, politician, and finally governor-general of a great country, he wrote 65 books (one for every year of his life), though for most of the time only his week-ends and long summer vacations were free for writing.

Son of a Scottish Free Church minister, Buchan had his higher education at the Universities of Glasgow and Oxford, read law, and was called to the Bar by the Middle Temple in 1901 (*see* BARRISTER). He next spent two years in South Africa on Lord Milner's staff. Then came many books, in a series which had begun as early as 1896. Before the First World War he had become a director of the publishing firm of Nelson, and of Reuters, the big London news agency. During that war he served first as news-service chief in France and then as Director of Information in London. He produced a four-volume *History of the Great War* in 1921–22.

In 1927 Buchan entered Parliament as a Conservative, and kept his seat, for the Scottish Universities, till 1935, when he was raised to the peerage as Baron Tweedsmuir on appointment as governor-general of Canada. His charm and tact and devotion to duty made him much beloved there.

Buchan's novels are the production of a magnificent story-teller, who seizes the reader's interest with the first page and holds it keenly to the end. Best known are three concerned with the First World War—*The Thirty-Nine Steps* (1915), *Greenmantle* (1916), and *Mr. Standfast* (1919) ; but no less rapid and thrilling are the stories placed in the Scottish scene, like *The Three Hostages* (1924) and *John Macnab* (1925), and the eerie *Witch Wood* (1927). Several made excellent films. His biographies included studies of Caesar, Cromwell, and Sir Walter Scott.

Buchan was, in what little leisure he allowed himself, a keen outdoor man, rock-climbing, deer-stalking, and fishing being favourite pursuits. He was deeply Scottish in character and sympathy. And one biographer says of him : "He remained throughout his life a Christian who said his prayers, read his Bible, and knew *The Pilgrim's Progress* almost by heart."

Bucharest, RUMANIA (pron. bōōk-*arest'*). The picturesque capital of Rumania is situated in a fertile plain about 30 miles north of the Danube. Along some streets there still stand quaint old one-storey houses covered with plaster and decorated with brilliant Oriental figures. The more modern parts of the city, however, are modelled on Paris ; in one thoroughfare the visitor might imagine himself in the Champs Élysées, and the Place de l'Étoile is copied, even to an Arc de Triomphe, in the Place Victoria. The law courts, royal palace, cathedral, and post office are handsome modern buildings. The special charm of the city lies in its well-kept public gardens and the greenery of the boulevards. Oriental costumes and customs are frequently met, although on the whole Bucharest has adopted Western ways of living. Its streets are broad and well paved and lighted, and there are electric trams. Schools are

numerous and the University of Bucharest is regarded as one of the best in eastern Europe.

For centuries Rumania was held by the Turks, as the provinces of Moldavia and Wallachia; but it became independent and united, and in 1861 Bucharest was made the capital of the new kingdom. The city was occupied by the Germans in the First World War from December 6, 1916, until after the armistice of November 1918. Bucharest was bombed by the Allied air forces on many occasions during the Second World War, and by the Germans after Rumania's acceptance of the Russian armistice terms on August 24, 1944.

There was considerable industrial expansion in Bucharest before the Second World War. Textile manufacture from imported materials was developed; flour milling and chemical and metallurgical industries are flourishing; and the city is a great oil distributing centre. There is also transit trade in timber and agricultural produce. The population of Bucharest at the census held in 1956 was 1,236,906.

There were four treaties signed in Bucharest. The first, on May 28, 1812, ended the war between Russia and Turkey; the second, March 2, 1886, made peace between Bulgaria and Serbia; the third, August 10, 1913, ended the Second Balkan War; and the fourth, May 7, 1918, between Rumania and the Central Powers, was annulled by the defeat of the latter six months later.

Buckingham, Duke of. This English title has been borne by the families of Stafford, Villiers, Sheffield, and Grenville, with intervals, from 1444 to 1889. The Stafford title became extinct when the third Duke, having displeased Henry VIII, was executed in 1521. Nearly 100 years later—in 1615—there appeared at the court of James I a young man of good looks and polished manners but small ability, named George Villiers (1592–1628). He became the king's favourite, and within seven years was made Earl, Marquess, and Duke of Buckingham, Knight of the Garter, and Lord High Admiral.

He was made by James companion to Charles, Prince of Wales, and became devotedly attached to him; to King James the favourite was known as Steenie, while the Prince of Wales was Baby Charles. Villiers took Prince Charles to Spain in 1623, and for a time gained great popularity by urging war with Spain. He brought about the mismanaged expedition to regain the Palatinate for the king's son-in-law, the Elector Frederick, and the equally mismanaged naval expedition to Cadiz in 1625. In the reign of Charles I he was perhaps the most powerful man in England, and one of the most mischievous. He led the expedition to the Isle of Ré, which failed to relieve La Rochelle, a port on the west coast of France, in 1627; and in the following year he was fiercely attacked by Parliament, but retained the complete

CALEA VICTORIA IN THE CITY OF BUCHAREST

The more modern parts of Bucharest, the capital of Rumania, were modelled on Paris, and there is even an Arc de Triomphe in the Place Victoria, which is at one end of the Calea Victoria. The city is situated in the midst of a fertile plain, and one of its functions is to serve as a market for oil, timber, and agricultural produce.

BUCKINGHAM AND HIS FAMILY

George Villiers, the first Duke of Buckingham, called Steenie by King James I (1566–1625), was the closest friend of Charles I (1600–49). He exercised great influence over both monarchs, and though he mismanaged the expeditions to Cadiz, Spain, in 1625 and to La Rochelle, France, in 1627, he retained Charles's confidence. This portrait of Buckingham and his family, by Gerard van Honthorst, is in the National Portrait Gallery, London.

confidence of the king. While making preparations to lead another expedition to La Rochelle, he was assassinated at Portsmouth by John Felton, a soldier who had a grievance against him.

The next Duke of Buckingham, who was born in 1628, the second son of George Villiers, fought against Cromwell and lost his estates, but lived to regain his fortunes and win great favour with Charles II. He was widely esteemed as a wit and a leader of fashion. He died in 1687.

Buckingham Palace. This great house is one of the "sights" of London which no visitor wants to miss, not because it is beautiful like Hampton Court, or because it is very old like Windsor Castle, but because it is the home of Queen Elizabeth II, as it was of five monarchs who reigned before her.

Strangely enough, the king who built it, George IV, died—in 1830—before it was ready for him to occupy. His brother, King William IV, who reigned after him, disliked the place so much that he refused to live there, although he consented to finish it; and it was not until 1837, when the eighteen-year-old Queen Victoria came to the throne, that the house became the home of the Sovereign. At the time of her coronation, in 1838, *The Times* still called it "the New Palace."

The young Queen called her new home Buckingham Palace because it was built on the site of a house which had belonged to the Duke of Buckingham in the days of Queen Anne. It remained in the Duke's family until 1762, when King George III bought it for £28,000. In the following year the King and his wife, Queen Charlotte, moved into Buckingham House, as it was called—later it was re-named Queen's House—and twelve of their thirteen children were born there.

Upon the death of Queen Charlotte in 1818 the house came into the hands of her eldest son, afterwards George IV, who already had in his mind some very grand ideas about rebuilding it. By 1825 he was ready to begin, and although he pretended at first that all he was doing was to "alter and repair" the house, in fact he had it pulled down altogether. Then he got his architect, the famous John Nash, to build him something quite new in its place; but the King died before it was completed.

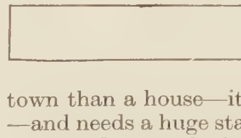
Buckingham Palace as it left the builders' hands looked rather different from the Palace as it is to-day. It was built round three sides of a central courtyard, in the manner shown in the diagram below.

In 1846–47, after Queen Victoria had lived there for ten years, the fourth side was added, closing in the courtyard (now called the Inner Quadrangle).

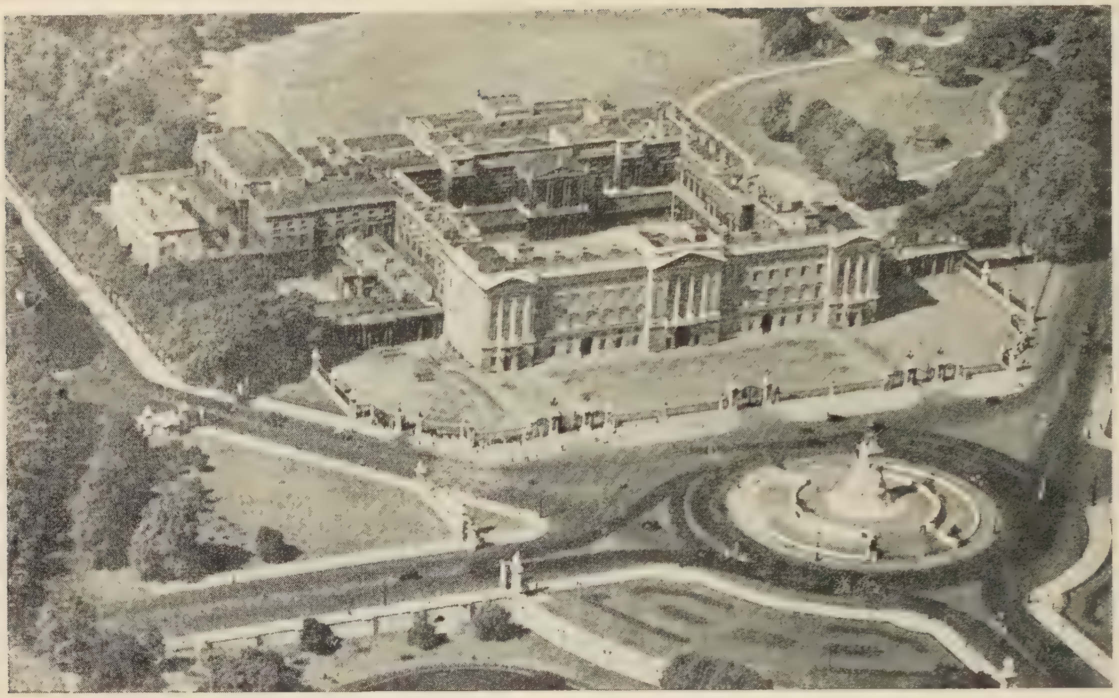
The grand archway which had served as the principal entrance was removed to a site at the junction of Oxford Street and Edgware Road, where once the Tyburn gallows stood. You can see it there to this day; it is called the Marble Arch.

In 1913 that fourth side, which is called the East Front, was re-designed and given a new face of Portland stone. The builders were allotted only three months in which to do it. By employing 380 men to work by day and 180 to work at night, using flares, the job was finished on time, and King George V invited all the workmen to a celebration dinner at a London restaurant.

The only clear view you can get of the Palace from the outside is of the East Front, which faces down The Mall, but if you ride down Grosvenor Place on the top of a bus you can enjoy a glimpse of the lovely gardens that lie on the other side of the spike-topped wall, including the little ornamental lake and the tennis court where King George VI used to play lawn tennis with some of his friends.



Buckingham Palace, with its hundreds of rooms and endless corridors, is more like a little town than a house—it even has its own post office—and needs a huge staff to look after it. There are acres of floors to be kept clean, hundreds of pieces of furniture to be dusted and polished. Besides ordinary vacuum cleaners, the Palace servants are equipped with every sort of brush imaginable, many of them specially designed. Some have enormously long handles for reaching the lofty carved ceilings; others have their corners padded with velvet to protect priceless pieces of furniture



BUCKINGHAM PALACE SEEN FROM THE AIR

In this photograph of the Queen's home, taken from an aeroplane over St. James's Park, the fine situation of the palace can be appreciated, surrounded as it is by parks and its gardens. In the angle formed by Buckingham Palace Road (left) and Constitution Hill (right), it faces the Victoria Memorial and the Mall, leading to Trafalgar Square.

from being scratched. It has to be remembered that the Palace is a storehouse of pictures and art treasures so valuable that no one has ever been able to put a price upon the whole collection, although some experts have guessed it to be worth something in the region of £4,000,000.

Some of the people who work at the Palace have strange duties. For instance, visitors staying there have sometimes been startled to meet the Vermin Man with his special "treacle trap," which has lured so many of the Palace mice to a sticky end!

Buckingham Palace was bombed nine times during the Second World War. Among the damaged parts were the swimming pool and the private chapel in which Queen Elizabeth II and Princess Margaret were christened.

Buckinghamshire. The Chiltern Hills form the main natural feature of this south midland county. They cross from south-west to north-east, and their chalky slopes and beech woods give rise to much beautiful scenery within easy reach of London. Buckinghamshire is a small county, being only 749 square miles in area, but from north to south it stretches 53 miles from the Midlands to a point about 15 miles from central London. Its width from east to west varies from $8\frac{1}{2}$ to 27 miles.

North of the Chilterns the country is gently undulating, with a group of isolated hills to the west and north-west of Aylesbury, of which Muswell Hill, Brill, and Quainton Hill are the most prominent. Aylesbury (population in 1951, 21,054), in the centre of the county, is the county town. Buckingham, the county town until the mid-19th century, is in the north. Near it is Stowe public school. Olney, home of William Cowper, and Wolverton, with railway works, are also in this part of the county, which is drained by the river Ouse. The Thame drains the vale of Aylesbury, noted for its dairy produce, between the Chilterns and the Quainton Hills. Other towns north of the Chilterns are Newport Pagnell, Bletchley, Linsdale, Wendover, and Princes Risborough.

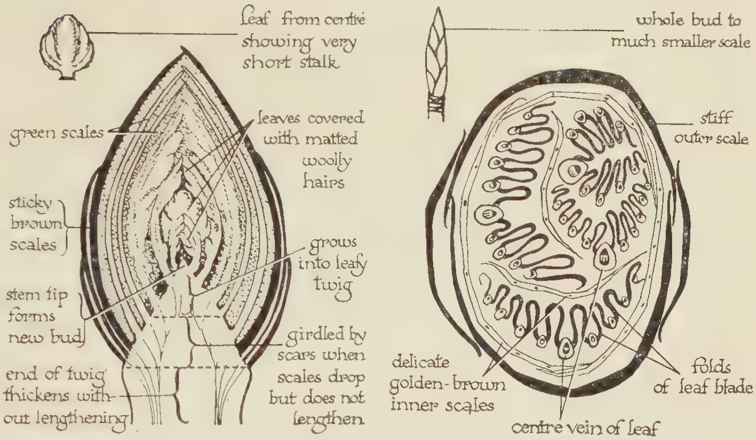
The Chiltern Hills take up the centre of the county, which contains their highest point, Haddenham Hill (857 ft.). Prominent are Coombe Hill, above Wendover, and Ivinghoe Beacon. In the Chilterns are High Wycombe, headquarters of the English furniture industry, the near-by beech woods supplying much of the raw material; the district known as the Chiltern Hundreds round Chesham; Amersham; Chequers, the official country home of the Prime Minister; and Hampden House near Great Missenden, home of John Hampden the famous parliamentarian. In the lower Chilterns are Beaconsfield, from which Disraeli took his title; the beautiful Chalfont villages—at Chalfont St. Giles, Milton's cottage remains; and Jordans, where William Penn is buried.

The extreme south of Buckinghamshire adjoining the Thames is flat. Here is the largest town, Slough (population in 1951, 66,439), an industrial centre and celebrated as the place where Sir William Herschel made his many astronomical discoveries. Near to Slough are Eton College, on the Buckinghamshire bank of the Thames; Stoke Poges, scene of Thomas Gray's "Elegy in a Country Churchyard"; and the lovely Burnham Beeches.

The population of Buckinghamshire in 1951 was 386,164.

Bud. Every shoot, stem, and branch of a plant is developed from a bud. The shoot, stem, or branch has a bud at its tip all the time that it continues to grow in length, and there are similar buds along the sides. A bud is either a leaf bud or a flower bud. The difference is easily seen in fruit trees during winter: a leaf bud is slender and pointed, a flower bud is rounded and fat.

Dormant buds are protected against the weather in a variety of ways. Sometimes the scale leaves that cover a bud are waterproofed with a resinous substance. How stickily effective this is will be appreciated if you carefully pull aside the wrappings of a horse-chestnut bud.



HORSE-CHESTNUT AND BEECH BUDS

Inside the horse-chestnut bud (left) each leaf is like a hand in a woollen glove. The woolly hairs prevent the leaves from drying up when they open in March. Brackets inside the drawing are merely graphic signs. On the right is a section of a beech bud, as it might appear under a microscope.

In essentials, there is a common structure for all buds, whatever the plant to which they belong. The brussels sprouts on the dinner table are buds. One is easily examined if cut through the centre from top to bottom. Here there are not any tough scales to protect the bud, but tightly packed miniature leaves. Each bud arises from the axil of a growing leaf (angle between leaf and stem). In some plants—the tiger lily, for example—buds in this position fall from the stem to the ground during summer and there send out roots and become new plants.

All buds have a tremendous urge to grow, though some necessarily remain dormant for many months. If the end of a shoot becomes broken, a dormant bud below that point suddenly wakes up and takes upon itself the further extension of the shoot concerned. A dormant leaf bud can be snicked from a rose bush when the latter is in full flower and then be slipped into a cut made in the bark of a briar rose. In a week or two the transferred leaf bud will prolong itself into a shoot, the base of the shoot meanwhile welding itself into the tissues of the foster parent and becoming part of it. In this way nurserymen increase stocks of a chosen variety of rose, the foster parent being induced to adopt three or more buds. The operation is called budding.

Budapest, Hungary. The capital and centre of the commercial, industrial, artistic and intellectual life of Hungary, Budapest is situated on the river Danube. The city is made up of two towns, Buda on the west bank and Pest on the east. The site of Buda, on the hilly side of the river, commands the plain to the east and forms a natural fortress, and here the Romans built an outpost called Aquincum. This was captured by the Huns in the fifth century. The Hungarians, or Magyars, reached the country in the ninth century and from the 13th century Buda was the capital of their kingdom. Pest, on the flat side of the river, was not important strategically, but with its easy access to the Danube, became a big trading centre. In 1241 it was sacked by the Mongols. When the Asiatic invaders left six years later, the Hungarian king re-peopled it with colonists, many of whom were Germans.

Both towns were enriched during the next few hundred years by the art and architecture brought by French crusaders, Italian artists, and Flemish merchants. But in the first half of the fifteenth century they were occupied by the Turks, who left little but ruins behind them when they departed in 1686. Maria Theresa (1717–80: see article), the great Austrian empress, revived the towns' fortunes, and in 1783 the Hungarian government was reestablished there.

The two towns were united in one municipality in 1872, and then expanded rapidly. Fine boulevards and public buildings, and huge factories and mills were built, and in Pest one of the largest electrical works in Europe grew up. The population grew from 54,000 in 1800 to 700,000 in 1900, and by 1956 it had reached 1,757,000.

In 1918 the breaking up of the Austro-Hungarian Empire into small states, each with its own customs barriers and import restrictions, divorced Budapest from many of its trade outlets, and its commerce declined disastrously, not reviving until the late nineteen-twenties. In the Second World War over half the city was destroyed by Allied air-raids and by fierce battles between the Germans and the Russians.

In October 1956 a nation-wide revolt broke out against the Communist government which had been imposed on the country by the Russians after the war. The people demanded the removal of the Russian armies from Hungary, and attacked government offices and secret-police barracks. On the pretext of entering into negotiations about the withdrawal of their troops, the Russians suddenly moved great concentrations of tanks and artillery into Hungary, and on November 4 launched a savage assault on Budapest, systematically destroying whole streets. Despite heroic resistance, the virtually unarmed people of the city, led by soldiers of the Hungarian army, were defeated in fighting that lasted over a week. More than 25,000 Hungarians were killed in Budapest alone, and for weeks afterward the city suffered a near-famine. Life slowly returned to normal with the Russians and the Hungarian Communists as firmly entrenched as before.

Buddha (*c.* 560–440 B.C.). Founder of the religion known as Buddhism, Buddha was a Rajput prince (of the Sakya clan) named Siddartha Gautama, from which fact he is often called Gautama (or Gotama) the Buddha, and Sakyamuni. In early youth he displayed deep interest in the welfare of all living things, studying their miseries and sufferings as well as he was able. His father, the king, did his best to hold his son back; he kept him confined to the palace and surrounded him with all the valuable and treasured things of life. At 28 he married, and when he was 29 his wife bore him a son, Rahula.

One night while his wife and son were sleeping, Siddartha bade them a silent farewell, clothed himself in a single, long cotton garment and set out from the palace to satisfy the inner calling for service to his fellow men. He became a wandering monk, seeking everywhere the peace of mind which all men strive for but so seldom find.

RUSSIAN ARMOUR ABLAZE IN A BUDAPEST STREET

In October 1956 the people of Hungary rose against the Russian-sponsored Communist government, demanding the withdrawal of Russian troops from Hungary. On November 4, Russian guns, tanks, and infantry assaulted Budapest, and in fighting that lasted more than a week about two square miles of the city were devastated. Most of the important public buildings, including the Parliament buildings, the National Museum, and the Opera House, survived.

BUDDHA'S PLACE OF ENLIGHTENMENT

It was while meditating under a fig tree in the forests of Gaya, in the Indian province of Bihar, that Siddartha Gautama, as Buddha was originally called, received enlightenment. Beside the tree a shrine was built, followed later by a large temple, the famous Buddh Gaya ; and near the west wall of this is a large fig tree, seen on the right in this picture, perhaps the descendant of the one under which Buddha sat. Pilgrims come here from all over the Orient.

He talked with men of all beliefs, he discussed suffering and pain with priests and beggars, he fasted until he almost starved to death. None of these practices brought him the peace that he sought. To and fro along the Ganges valley he went, finally seeking rest for his weary limbs under an old tree at Gaya, near Patna. Here he passed several weeks in deep meditation on the troubles and trials of mankind in this "dusty world"; suddenly there was revealed to him a better way of life for men.

Now about 40 years of age, Buddha set off on his journeys of instruction. He gathered companions about him, with whom he discussed all the details of his enlightenment and prepared the teaching (a purified form of Hinduism) by which all men on earth might reach the same state of mind. Buddha made it clear that he did not pretend to godhead; what had happened to him (enlightenment) had happened to other men before his time and could happen in the future to all who would follow his teaching. He taught that all men suffered because of three great sins — selfishness, ignorance, and lack of good will to others. If these were conquered and the mind given over to contemplation, the problem of life and duty would be solved.

BUDDHA IN JAPAN

This bronze statue of Buddha, at Kamakura in Japan, is 50 feet in height and 36 feet from knee to knee. There are windows in the shoulders, to which access is gained through the hollow interior

Although Buddhism became a religion with some 150,000,000 followers in Asia, it is as a philosophical system, a way of thinking, that it first came to the West. Many German thinkers were greatly attracted by it in the 17th and 18th centuries and worked Buddhist theories into their own philosophical systems.

The scriptures of Buddhism, unlike the Bible and the Koran, are not considered books of divine revelation. They are the recorded sermons or addresses and dialogues of Buddha during his teaching life ; they set out the standard of conduct needed to reach the state of Buddhahood. According to one part of the teaching, life is a succession of cycles through which a man must pass according to his deeds on earth. He may be reborn many times before he frees himself from worldly desires and selfishness, but the hope is held out that all who earnestly try may one day become Buddhas. The universe had no beginning, and therefore

THE FRIENDLY BUDGERIGAR

Immensely popular as a pet, the budgerigar is an Australian parrakeet, and in its wild state is mainly green and yellow, but many are blue. It can be taught to talk.

no creator and no God ; it will have no end, for there will always be some on the way to becoming Buddhas, however slowly they may make progress. The ultimate aim is the achievement of Nirvana, a state of inactive, perfect calm, in which the once restless spirit is at one with all the Buddhas.

The teaching of Buddha spread over the whole of the Far East and is to-day a growing influence in Europe. In Mongolia and Tibet are special forms of Buddhism known as Lamaism. These forms are mixed with earlier local beliefs and are less pure than the Buddhism of Ceylon (nearest to the original teaching), India, China, Korea, and Japan.

Budgerigar. This is the native name of the Australian long-tailed grass parakeet, which ornithologists (the people who study birds) call *Melopsittacus Undulatus.* For most of the year the wild budgerigar lives among the short bushes of the Australian coastal regions, where it feeds on seeding grasses. It is an exceedingly thirsty bird and flies great distances in search of water.

At the breeding season budgerigars hollow out nests in the trunks and branches of the eucalyptus gum trees. No lining material is used for the nests, in which the hen bird lays three or four white eggs, which make their appearance every other day. The eggs take from sixteen to eighteen days to hatch. The chicks are at first quite naked and have exceptionally large heads. Three or four days after hatching, the tiny bodies are covered with a yellowish-white down, and on the fifth or sixth day the feathers begin to break through. At the twelfth day the birds open their eyes, and thereafter grow very fast, being fully-fledged, ready to leave the nest, when a month old.

In their wild state budgerigars have a uniform plumage in which green and yellow are the chief colours. The forehead and crown are bright yellow ; the back of the head, cheeks, and wing coverts are greyish-yellow barred with black ; the shoulder feathers have an emerald-green tint ; and the chin and throat are bright yellow with a necklace of black spots, the upper spot on each side being nearly hidden by patches of dark ultramarine blue. The chest, underparts, thighs, and under-tail coverts are bright grass-green, and the upper tail coverts a bluish-green shade. The primary feathers are a deep grey tipped with yellow. The two middle tail feathers are deep prussian blue and the rest of the tail is bright yellow tipped with green. The bird has a pale yellow beak and pinkish grey feet. Above the beak is a fleshy substance called the wattle which in both the wild and the domestic bird is always purple-blue in the male and pale blue or brown in the female.

Budgerigars were first brought to Britain in 1860, but they were seen only in zoos until the beginning of the present century. Since then they have steadily become popular as domestic cage-birds and to-day rival canaries as pets.

At first the domestic budgerigar was either green or yellow, but since the 1920s breeders have succeeded in producing a great variety of colours, the chief being : mauve, white-mauve, dark green, light green, apple green, sage green, olive green, yellow, dark yellow, yellow olive, sky blue, cobalt, white-blue, white-cobalt and white. Whatever its colour, and whether wild or domesticated, the budgerigar is $9\frac{1}{2}$ inches long from the crown of its head to the tip of its tail and seldom weighs more than $1\frac{3}{4}$ ounces.

Because it is a naturally active bird, a budgerigar must be kept in a roomy cage ; there is nothing more cruel than to keep one of these lively little birds in cramped quarters. A good size for a cage is 30 inches long, 20 inches high, and 12 inches from back to front. A box-type cage with wired front gives better protection from draughts than an all-wire cage. The inside of the box should be painted with an enamel that does not contain lead, and a similar kind of black enamel should be used for the wire front. Enamelling the wire black shows the bird off to the best advantage.

There should be at least two perches in the cage and these should be placed as far apart as possible so that the bird has a good distance to jump and flutter from one to the other ; but they should not be too close to the sides of the cage, otherwise the budgerigar's tail feathers may be damaged. The cage should also contain a ladder and two or three playthings ; budgerigars are such " busy " birds that they like to be occupied.

Although budgerigars are hardy birds, some care is necessary in choosing the position of the cage. The best place is a sunny room with an even temperature, and the cage must be placed where it has plenty of fresh air without being in draughts. In summer it must not be left directly in the sun's rays.

Budgerigars like nothing better than to be allowed out of the cage to fly about a room and explore. But before opening the cage make certain that all doors and windows are closed and fire-places covered. A budgerigar always flies towards an opening, and if it gets outside a house it is inevitably lost, and will probably die of starvation as it will be unable to get proper food. Never allow a cat in the room where a budgerigar is

uncaged. Only very rarely can even the most domesticated cat resist attacking any bird.

The most successful diet for budgerigars is one part canary seed, one part white millet, and one part red millet. Spray millet is much appreciated, but should be given sparingly. Another favourite food is dry oats, but as these are somewhat heating they should be fed to the birds only in winter. Like all small birds in captivity, budgerigars are fond of, and thrive on, green foods such as watercress, lettuce, cabbage, spinach, groundsel, chickweed, and dandelion, while all kinds of flowering grasses are good for them. Green food of any kind must be fresh, and any rejected stale greens must be removed.

The notion that budgerigars dislike water is quite wrong, for, like all members of the parakeet family, they are fond of it and drink freely. They also like an open dish of water to bathe in. Dried cuttlefish, and old mortar or fine grit should always be available for the birds as these help them to grind up the eaten food and so aid digestion.

Budgerigars periodically moult, that is, cast feathers, and at these times the birds should be given linseed, which acts as a tonic and helps to grow new close and glossy plumage.

Although budgerigars will eat bananas, pears, apples, oranges, grapes, and most other fruits, it is not wise to let them do so except very occasionally. They keep in sound health and good feather condition when plainly fed on good seed and fresh greenstuffs.

The budgerigar is the easiest of birds to look after. Proper diet and a few minutes' daily attention to its cage will keep it healthy and happy. Drinking water should be renewed daily, food dishes washed out, and husks and stale food removed. Soiled sand must be taken from the floor of the cage to prevent the birds from eating seed spilled on the floor and contaminated by droppings. Once a week the bird should be taken out, and the cage and perches thoroughly washed with warm soapy water and afterwards rinsed and wiped over with a cloth.

Budgerigars are natural mimics of h[illegible] speech, but teaching them to repeat name[illegible] short sentences needs patience. The best a[illegible] at which to begin teaching the bird to talk is when it is under six months old; indeed, a fledgling straight from the nest is often the quickest pupil. Talking lessons must be given in a quiet room where there are no glittering or moving objects to distract the bird's attention. Tuition should begin with single words repeated over and over again in a soft voice until the bird can successfully imitate them. When a few short, single words have been mastered, the bird's vocabulary can be joined to form simple sentences of three or four words. Never change the order of the words of the sentence being taught, or the bird will become confused.

Many people still confuse budgerigars with love-birds. In fact there is no relationship whatever between them. Love-birds belong to the short-tailed parrot family and originally came from Madagascar.

Buenos Aires, ARGENTINA (pron. bwā′-nos ī′res, or, anglicised, bū′nos ärz). Certainly the largest, in many ways the handsomest, and perhaps the healthiest city of South America is Buenos Aires, capital of Argentina since 1853. At that time its population was about 76,000; in 1957 it was just over 3,500,000.

The first settlement on the site was made by Pedro de Mendoza in 1536 (new style), but the Indians drove the settlers away five years later. On June 11, 1580, another group of people led by Juan de Garay began a settlement on the same spot, giving it the name Santos Trinidad y Puerto de Santa Maria de Buenos Aires (Holy Trinity and Harbour of Our Lady of Kind Winds)—a very long name that was soon shortened to the last two words.

Kind winds helped the settlers to reach the site in their sailing ships, and kind winds help to give it a delightful climate. The average temperature in winter is about 50° F., in summer about 80° F. Snow never falls, though there is sometimes frost. About 36 inches of rain fall in the year, distributed

BUENOS AIRES, CAPITAL CITY OF ARGENTINA

At one end of the Avenida de Mayo is the Plaza del Congreso, one side of which is occupied by the marble-domed building where the Congress of the republic meets. The boundaries of Buenos Aires enclose an area of more than 70 square miles, and the population of the city is some 3,500,000. It is finely situated, and very skilfully laid out.

SHIPPING IN THE HARBOUR OF BUENOS AIRES

The docks of Buenos Aires stretch along the south bank of the Rio de la Plata, or River Plate, and through them passes more than half of Argentina's exports of meat, grain, wool, and livestock. The Rio de la Plata is the estuary, 100 miles long, through which the rivers Uruguay and Paraná discharge their waters into the South Atlantic. It has a maximum width of about 56 miles, and makes a magnificent harbour for this great southern port.

through the seasons. Flowers bloom in its parks and avenues all the year round.

Buenos Aires lies on the right bank of the Rio de la Plata, the great estuary through which the rivers Uruguay and Paraná discharge their waters into the South Atlantic (*see* ARGENTINA map, Vol. 1, p. 223). It is 123 miles above Montevideo, capital of Uruguay, on the opposite bank. Its growth dates from 1855, when the first landing mole for passengers was built. The first railway to the interior was opened in 1857. It has good local steamship services, and several underground railways, and is linked by air with the neighbouring countries of South America, as well as with Europe and the United States of America.

The city is well planned, with a network of roads crossing one another at right angles. It has few old buildings ; new building goes on continually. An ambitious piece of reconstruction was the making, just after the Second World War, of the Avenue of the Ninth of July, so named to commemorate Argentina's declaration of independence from Spanish rule on that day in 1816. To build this avenue (said to be the widest street in the world), many houses had to be knocked down—a fact that made it rather unpopular, for Buenos Aires, like many other cities, was short of homes.

Buffalo. Although the name buffalo is often used for the American bison (see article), it should really be applied only to some members of the cattle tribe found in tropical Africa and Asia. The water buffalo still lives wild in many parts of India, but it has been domesticated for centuries and many millions are kept as working animals, especially for use in ploughing swampy land. The water buffaloes used in the fields of Egypt and southern Europe were originally introduced from India. The Philippines buffalo is generally called the tamaru, while the Celebes Islands have a dwarf form known as the anoa, which stands only about 40 inches at the shoulders.

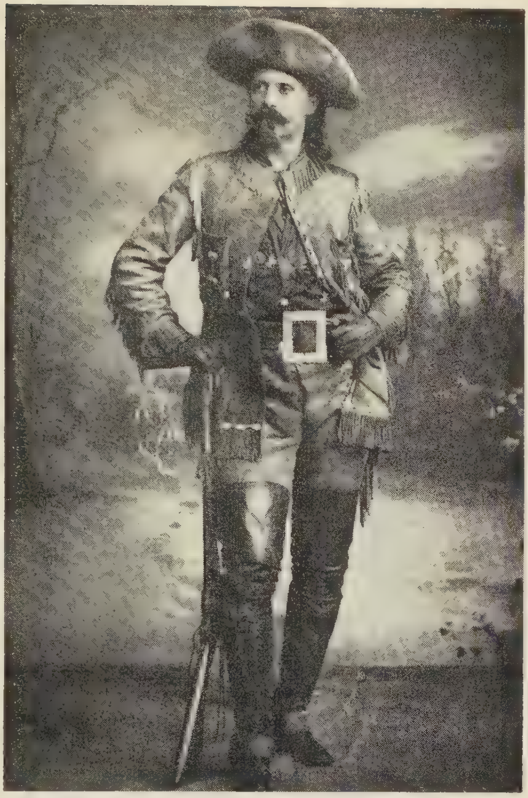
The Cape buffalo or bush cow is also fond of water, and it lives in all suitable country in Africa south of the Sahara, seldom being found far from watercourses. Both bulls and cows have horns and although these vary very much in shape and length, they are always flattened and heavily thickened at the base, forming a protective shield over the forehead, which makes a fatal shot from the front impossible. This kind has never been domesticated and it is often reckoned to be the most cunning and dangerous of African big game. It goes about in herds, often accompanied by flocks of starling-like birds called ox-peckers which help

clear the animals' hides of ticks and give warning of any danger. Asiatic buffaloes belong to the genus *Bubalus*; the Cape buffalo is *Syncerus caffer*.

Buffalo Bill (William Frederick Cody, 1845–1917). What boy has not heard of Buffalo Bill, the famous North American scout who fought against the Red Indians? Born in Iowa, Cody became known while still in his teens for his daring as one of the riders of the Pony Express, which carried the mail from St. Joseph, Missouri, to Sacramento, California, a distance of 1,950 miles, by means of relays of ponies, each rider covering 75 miles a day. In this way Cody gained the knowledge of the plains and of the Indians which he used to such good advantage, after 1861, as scout for the United States army. Besides serving in the Civil War he took part in campaigns against the Sioux and Cheyenne Indians, performing many notable feats of skill and daring.

His name of Buffalo Bill was gained in 1867, when he contracted to furnish fresh buffalo (bison) meat to the labourers laying the track of the Kansas Pacific railway. To do this, it is said, he killed over 4,800 bison in 18 months, including 69 in one day.

In the early '80s Cody began collecting some of the most exciting and interesting things relating to the rapidly vanishing life of the plains. He gathered round him cowboys, scouts, and Indians, and organized a most elaborate Wild West show, with which he toured America and Europe for 20 years. The brave old fighter's tomb is such as he would have chosen for himself. His body lies in a vault blasted out of the solid rock of Lookout Mountains, Colorado, U.S.A.



"BUFFALO BILL"

Colonel William Cody, hero of a hundred stories of adventure amongst the Plains Indians of the United States, is here seen in the dress which he wore when touring with his Wild West cowboy and Indian show.

Buffon, Georges Louis Leclerc, Comte de (1707–88). Though little remembered to-day, Buffon was an author who in his time was lavishly praised for his style, and an observer who raised the study of nature to the level of a science. Before Buffon, nature was regarded as beneath the notice of learned men and philosophers; after the completion of his work the science of biology had been established and the entire outlook of thinking people had been changed. Buffon's contribution to knowledge was his huge *Histoire Naturelle* (Natural History), which he began in 1740 aided by other scholars. Thirty-six volumes appeared between 1749 and 1789, and the work was carried on after his death in eight more volumes, the last of which appeared in 1804. In it he surveyed the whole field of natural history. Though he was apt to generalise on an insufficient collection of facts, he realized that one species might change into another, and dimly foreshadowed the far deeper and wider conclusions of Darwin.

AFRICAN BUFFALO

The true buffalo is native to Africa and the Indian sub-continent, but the species differ greatly. The Indian buffalo can be domesticated, while the African animal is untameable. It is a cunning and dangerous quarry.

George Louis Leclerc, later Comte de Buffon, was born at Montbard in Burgundy in 1707. He studied law at Dijon and made the "grand tour" of Europe, visiting England on his travels. Having inherited a fortune at the age of 25, he was thereafter able to devote himself to science. He made his name by translating into French two English scientific works (one was Newton's *Treatise on Fluxions*), and in 1739 was appointed director of the *Jardin du Roi* (King's Garden, the French zoological gardens) and of the Royal Museum in Paris. He spent the rest of his life on his great work, dying in 1788. A man of fine presence, Buffon won the regard and esteem of his contemporaries. Two of his sayings will always be remembered: *Le style est l'homme même* (The style is the man himself), and *Le génie n'est autre chose qu'une grande aptitude à la patience* (Genius is only a great capacity for patience, *i.e.* for taking pains).

How the BUILDER GOES TO WORK

Building Construction. The article on ARCHITECTURE (Vol. 1) shows that the buildings of every country are influenced by the materials available and the technical knowledge of the builders of the time. This technical knowledge is the basis of building construction, and in countries where clay is suitable for brickmaking, buildings are mainly constructed of brick, whereas in places where stone and timber are readily available, these are the chief materials used. Even in the period since about 1920, with its wide use of steel and reinforced concrete, local materials are still in demand for facings and decorative work. For example, many modern buildings in Great Britain are faced with the traditional English brick, whereas similar modern buildings in Italy are faced with the traditional Italian marble.

The article on architecture revealed that large modern buildings generally depend upon a framework of either steel or reinforced concrete to take the weight of the structure, and this not only affects the appearance and design of the buildings, but also has a great influence on the method of construction. Since the First World War, building materials and methods have brought great changes to the art of constructing buildings, but in spite of all the progress made, many operations such as bricklaying are still carried out in much the same way as in Biblical times. (*See* BRICKS AND TILES.)

Whatever form of construction is used in any age, the basic requirements are the same. They are these. (1) Stability: the building must be able to stand up to weather and storm outside and the weight of the users and their equipment or furniture inside. (2) Weather resistance: all buildings must keep out the rain, wind, and cold, and must be constructed so that heating inside is not quickly dispersed through the walls. A house or factory must also be resistant to damp in the ground, and if it is near a river or spring, care must be taken to see that water does not penetrate into rooms at low levels. (3) Weathering: buildings must remain in a good condition for many years, whatever their construction, as owners cannot afford to keep on repairing them; and a well-constructed building will often last longer than its owners.

These three requirements are the principal aims of building construction, and every operation on a site should be organized so as to fulfil all or one of these standards. In large structures the frames taking the weight of floors and walls are usually either in mild steel or reinforced concrete. The

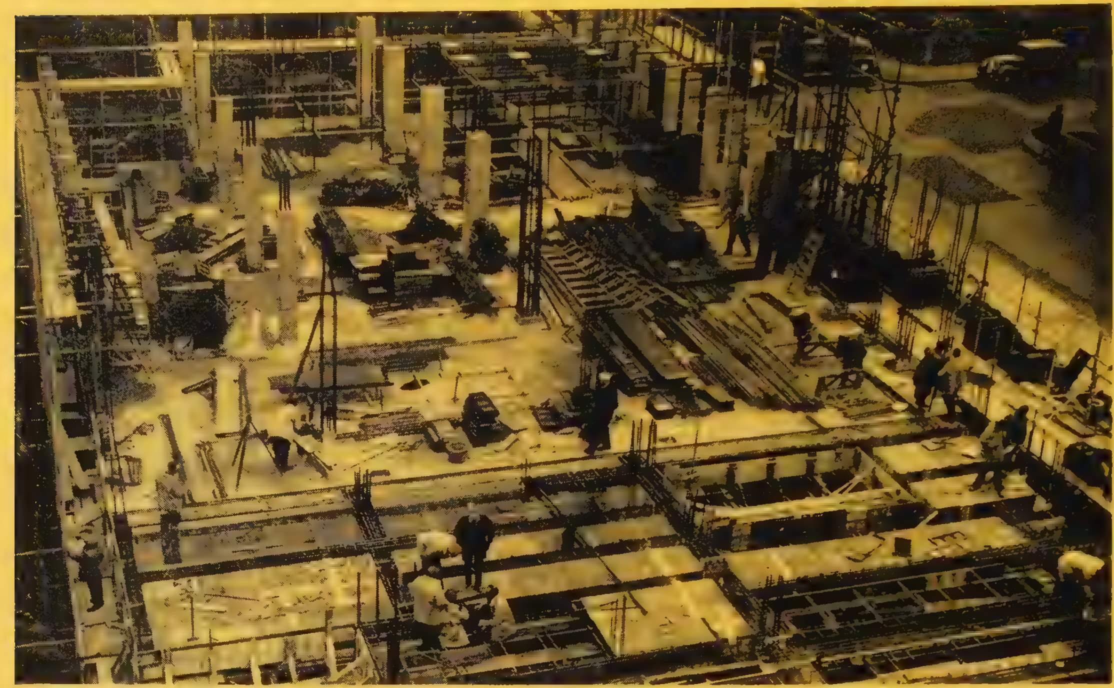
SETTING UP THE CONCRETE SKELETON OF A BUILDING

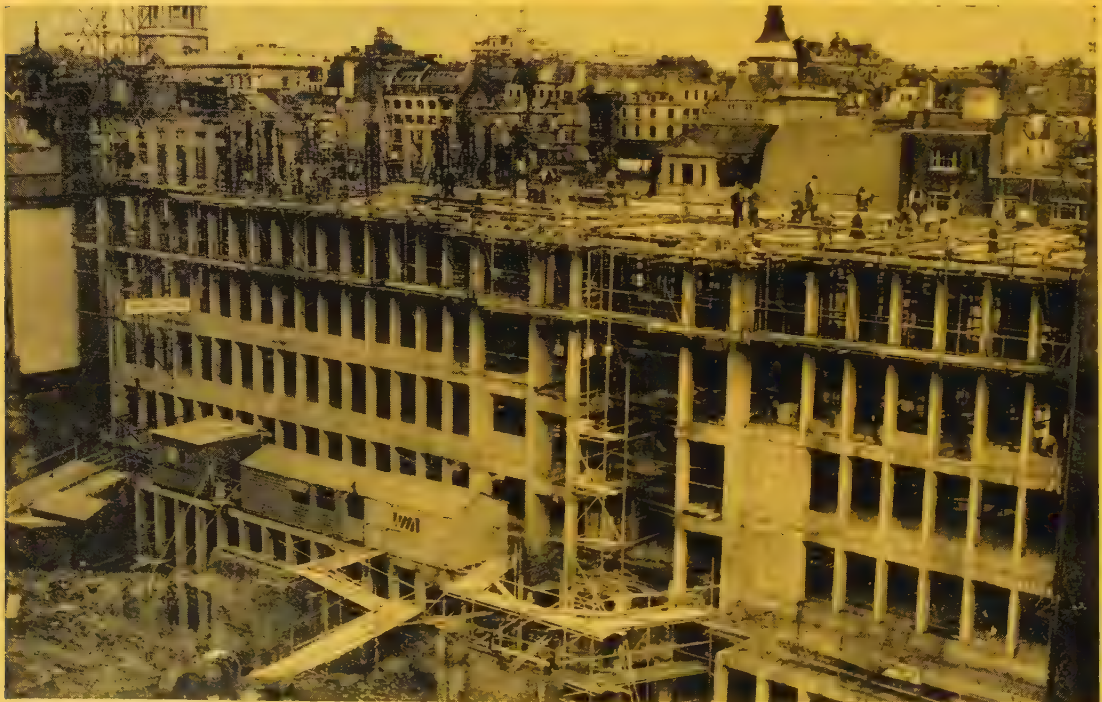
Large modern buildings generally have a framework of either steel or reinforced concrete. In this picture the reinforced concrete frame members of a factory have been prefabricated in readiness for erection on the site. The use of prefabricated parts prevents delay on the site owing to bad weather, and thus helps to keep down costs. To hasten the whole process of construction, more and more use is being made of machines of various kinds.

GROWTH OF A LONDON OFFICE BUILDING

The upper picture shows the site cleared for building work as it was on October 8, 1949. In the lower picture excavation for the foundations has been completed, and the bases to take the framework concreted. The lower photograph was taken on January 16, 1950. The site is very near the offices of THE BOOK OF KNOWLEDGE, and as it is close to the Thames there was trouble due to the flooding of the excavations. The contractors were Trollope and Colls.

CONSTRUCTING THE FRAMEWORK OF THE BUILDING





The upper photograph, taken on April 3, 1950, shows the basement concreted together with the ground-floor slab, and the construction of the reinforced concrete frame under way. The steel plates which hold the concrete in position can be clearly seen. By August 2, 1950 (lower), the concrete frame and floors are nearing completion. External walling in brick has been begun, and construction of the spiral staircase at the rear (see page 122) is in hand.

THE BUILDING IS NOW TAKING SHAPE

In the upper picture, taken on December 5, 1950, it can be seen that the concrete frame, floors, and roof are complete, the external walling almost finished, and the quartzite facing well in hand. Windows are fixed and glazed, and the spiral staircase constructed. By May 10, 1951 (lower), the external facing has been done ; the windows on the staircase are glazed ; and the work of finishing the whole job has now begun. Painting is in progress.

THE BUILDING READY FOR OCCUPATION

Here can be seen the front of the completed block of offices, which is known as St. Bridget's House. Every room above ground is exceptionally light and airy, and the general effect is one of simple dignity. The unsupported portico affords shelter to an unusually wide entrance. The architects were Trehearne and Norman, Preston and Partners. What appears to be a most incongruous structure stuck on to the roof is really the steeple of St. Bride's Church.

Aston Construction Co., Ltd.

STEEL FRAME FOR A NEW SCHOOL

When the foundations have been laid, a framework of steel can be erected. The frame seen here is for a school in Buckinghamshire, and on it will be carried the floors, roof, and external skin of brick or concrete. Because of the greater load they must carry, the floor girders are thicker than the upright girders of the frame, and will also be joined from end to end by linking girders, so that the whole fabric of the building is absolutely rigid and secure.

frame so constructed requires an outer skin to keep out the weather, and solid slabs to act as floors and roofs. Often the external walls will consist mostly of windows with panels of brick or stonework in certain places where windows are not required. For small buildings, however, a frame is not required, and the walls themselves act as supports for the roof and floors, at the same time serving as screens to keep out the weather. This more traditional form of construction must still comply with the three rules given above, but often one member like a wall will have to do two or three jobs.

One of the 20th-century developments in building construction is the use of a very thin shell of reinforced concrete, making use of curved shapes, and producing a membrane which can span great distances but remain very thin. This form of construction can best be compared with the shell of an egg, which is surprisingly strong in relation to its thickness. There is no doubt that during the years to come there will be many new devices in this technique and many other new materials and building methods will be developed.

The easiest way to understand how a building grows up is to follow the gradual growth of the structure from the days of the empty site to the finished building. The description which follows is a broad outline of the steps taken, and still applies in general principles to the erection of buildings both large and small.

The first stage, after the architect's designs have been approved, is for him to prepare working drawings, with a specification or description of the work, together with other information explaining to the builder exactly what he wants in his final building. The architect not only decides upon the size and shape of rooms and windows, but also chooses the type of bricks or stone to be used, selects and designs the doors and windows, instructs the various tradesmen how to fix the fittings and where he requires them ; and plans on his drawings the positions of drains and of gas and electric runs. Finally he chooses the sort of paint to be used and selects colours for the decoration.

The first stage of the builder's job is the clearing from the site of grass and trees, or other obstructions, and the digging of holes to take the foundations. These holes can be either long trenches for the bases of brick walls, or square holes to take the members of the steel or concrete frame. The foundations of a building are of great importance, for if they are not properly and solidly designed, the great weight of the structure will cause the building to sink and cracks will occur ; at the worst the building might even collapse. When the foundations are laid, the framework of steel or concrete can be erected by the expert workmen, or if the building has solid load-bearing walls, the bricklayers can start their work. Where bricks are used to carry loads, they are built in what is known as a bond, so that no vertical joint is over another vertical joint. This allows the weight on the walling to be carried through the solid brick and not through the weak joint, thus ensuring the strongest possible construction. An important factor when the building is still at a low level is the damp-proof course. This is a layer of water-

CONCRETE SPIRAL STAIRCASE

This staircase in St. Bridget's House, London, E.C., shows one of the many ways in which reinforced concrete can be used in modern building construction. High, wide windows form most of the wall surface, so that there is no need for electric lighting during daylight hours.

resisting material which is placed in such a position as to prevent the rising of damp from the ground through the walls which would cause wetness and rot later on. Older buildings are often found to be without a damp-course: as a result the building is damp and the woodwork is often affected by timber diseases.

After the damp-proof course is approved by the architect, the work of erecting the enclosing walls can continue. This work proceeds until the first-floor level is reached in erecting a load-bearing brick building, where the floors are constructed of wood or concrete resting on the walls. In a framed building, however, the two operations can proceed quite independently and you will often see a building with its frame complete and all its floors in position before the outside walling has been begun. While the outside walling is being continued, the window-frames and door-frames of wood or metal can be fixed in position and finally the roof structure is erected. It is always the aim of a builder to get the roof on as quickly as possible so that his workmen can work under cover, undisturbed by bad weather.

As soon as the roof is finished, specialists start on the inside. Partitions are erected to divide the interior into rooms, and electricians, gas-fitters, and plumbers proceed with the job of laying their pipes and cables for the supplies required. These will vary with the size of the building, and in large buildings there may be many miles of pipes and ducts and cables, carrying the essential services which have to be connected to the mains outside in the same way as the plumbing has to be connected to the main drains. The next task is to fix doors and frames and joinery work generally, put glass into windows, and plaster the rough partitions and ceilings. When these jobs are completed, the sanitary fittings and other similar items are fixed by the specialist tradesmen, leaving the job ready for the laying of special flooring and the final decoration by the painters.

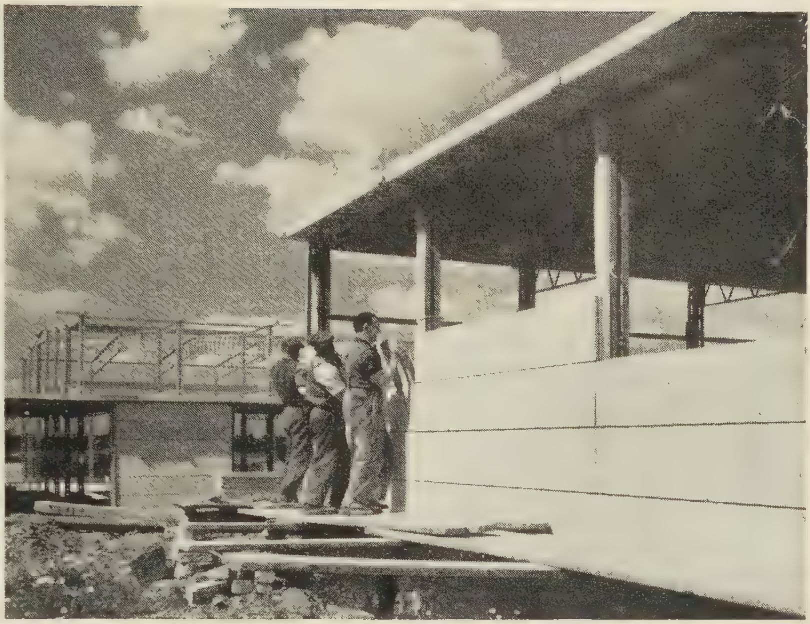
The decorations will, of course, depend upon the type of building. In hospitals and laboratories many walls will be tiled, and therefore will not need decoration; in houses and flats, walls will be either distempered or papered and the woodwork painted. Where special woods have been used for doors and joinery, these are cleaned down carefully and then polished to bring out the natural beauty of the timber. When all this is finished and the services are tested, the architect who has been inspecting the job all the way through makes his final inspection before the building is handed over to its new owner.

When small buildings are erected, most of the work is done by hand; bricks are carried in a hod by a labourer, and even concrete is often mixed by hand on the site. In a big construction programme this way of working would not be economical, and so mechanical hoists are used to take bricks and other materials to the various levels of the building, and sometimes huge cranes are erected to lift heavy pieces of equipment or materials. To speed up the work, a greater use is being made of machines both in the United Kingdom and abroad; and in America, especially in the United States, this development has been carried much farther than anywhere else.

Building construction in the future will obviously make a great deal more use of machinery, and because of the difficulty of bad weather, which sometimes stops work altogether, much more will be done in factories and taken to the building site in large sections. Already metal windows, joinery, staircases, and even plumbing units are made up in factories and delivered to the site complete, and undoubtedly in the future whole sections of wall made of light materials for easy transport will be made up in the factory and delivered by road or rail for quick erection on the site. This has already been done in a small degree in the various forms of prefabricated houses built in Great Britain and other countries after the Second World War; and in order to keep the cost of building down, this development is likely to continue.

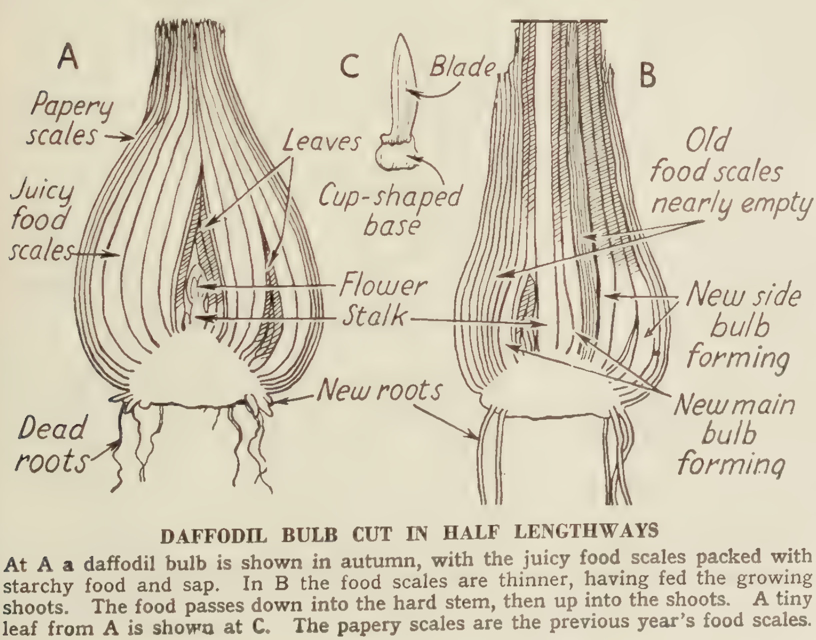
All buildings are heavy because they are normally constructed of heavy materials. This means that they require large foundations and large frameworks

to support their heavy walls. In future it is likely that there will be buildings with much lighter foundations and frameworks to take lighter panels of materials like aluminium, which weather well but require to be backed with something to keep in the warmth. Experiments have been made with cork, so that it is possible that in the future buildings will have very light steel frames clad with panels either of light concrete or of insulated aluminium. Such forms of construction will naturally affect the appearance of the buildings—which brings the argument back to the starting point—that materials and construction decide the appearance of buildings, and building construction requires stability, weather resistance, and weathering qualities.



BUILDING WITH STANDARD UNITS
This Hertfordshire school is being built with a light standard steel frame and faced with standard concrete units, or slabs, which interlock. All the prefabricated parts are designed on a unit basis to allow construction to be carried out rapidly, without too much care about weather, and the maximum amount of work to be done off the site.

Bulb. When a whole plant is telescoped down into one large underground bud, that bud is called a bulb. Such plants usually flower in spring, store up food in early summer, and rest, well protected by papery frost-proof and insect-proof covers, under the earth in autumn and winter. Inside a resting daffodil bulb (see diagram) there is a bun-shaped solid base, really a flattened stem, containing a little starchy food. The young roots for next year show as tiny, yellowish points round its rim, and in the centre is next year's flower surrounded by three or four minute yellow leaves with curious white cup-shaped bases fitting inside one another. This central shoot is surrounded by white juicy scales packed full of starchy food and sap. Last year the inner ones were the little cups at the bases of leaves, and the outer, thinner ones were inner, thick ones. The papery scales on the outside were white food scales last year and probably leaf bases the year before. Between some of the food scales one or two smaller shoots may be found, generally with leaves only. These form small new bulbs.



DAFFODIL BULB CUT IN HALF LENGTHWAYS
At A a daffodil bulb is shown in autumn, with the juicy food scales packed with starchy food and sap. In B the food scales are thinner, having fed the growing shoots. The food passes down into the hard stem, then up into the shoots. A tiny leaf from A is shown at C. The papery scales are the previous year's food scales.

Diagram B shows the food scales getting much thinner after giving food to the growing shoots. The food has to pass down into the hard stem, then up into the shoots; it cannot just move across. As soon as the new leaves are fully grown they manufacture food and send it down to swell their cup-shaped bases and what is left over goes down into the bulb stem and up into the innermost white scales. The oldest white scales remain empty and turn papery and the oldest papery ones of last year fall off. Although the leaves may look untidy

BULGARIAN PEASANTS CELEBRATING EASTER

In this land of villages where the majority of the people still get their living from the soil, traditional costumes are still worn, especially at such a festive occasion as an Easter dance in the village square. The Bulgarians, though originally descended from a people akin to the Huns, have become merged with the Slavs and have always been conscious of racial ties with the Russians. Tough and of fine physique, both men and women are hard working.

after the bulb has flowered, they should not be taken off, for without them food cannot be stored in the bulb for the next year.

Tulip bulbs are a little different in having scales which have never been leaf bases, and the tulip leaves send all their food down into the bulb stem and up into one or two buds. The covering scales of these buds swell and fill up the shrunken bulb. Lily bulbs have scales like thick flower petals, not going all the way round the bulb. Hyacinth bulbs will flower if grown perched on tall narrow vases containing water, but after flowering they should be planted in soil.

For many years Holland was the only important bulb-growing country in Europe, but thousands of acres in Lincolnshire now produce flower bulbs, as well as the Scilly Isles and Guernsey.

The vegetable bulbs of onion, shallot, and garlic belong to the same family as lily, hyacinth, and tulip—the *Liliaceae*.

Bulgaria. In the north-east of the Balkan Peninsula, bordering the Black Sea, and divided from Rumania along much of their common frontier by the river Danube, lies the country of Bulgaria. At the end of the Second World War this was still a land where 80 per cent. of the people were peasants, tilling their small plots of one to six acres with the methods of earlier centuries. Twentieth-century ways had reached the bigger towns, but had hardly touched the countryside. Wooden or iron ploughs drawn by oxen or water-buffaloes were still in common use, and sickles were used for reaping. Houses were generally dark structures lighted by oil lamps. Clothes were of home-spun material, home-made and hand-embroidered, the style of costume and embroidery varying with the district. There are still places where these conditions might be found, but collective farms are replacing the small plots, and tractors are ousting the ox and buffalo.

The Bulgarians are short and stocky, extraordinarily strong, hard-working, patient, and frugal. They adhere to the Greek Orthodox Church, though the church was disestablished (that is, it ceased to be the *official* church of the state) in 1949. There are more than half a million Mahomedans. Education was re-organized in 1950 in imitation of that in Soviet Russia. Primary education is free and compulsory, but there are still a number of adults, especially women, who cannot read or write.

Bulgaria has an area of 42,796 square miles, and a population of about 7,630,000. The capital is Sofia, housing nearly three-quarters of a million. Other large towns are Plovdiv, once called Philippopolis, after Philip of Macedon, and the ports of Varna and Burgas. The country is charming, with a variety of climate and scenery. The Balkan Mountains cross it from west to east, dividing it roughly into two districts. In the northern area cereals, especially wheat, are grown. The southern area is hotter in the summer, and here are centred silkworm-breeding, bee-keeping, vine-culture, and rose-growing. There are few more enchanting sights in Europe than the Kezanlik valley in June, with its great fields of rose bushes. The blossoms are gathered before dawn to preserve the scent. Attar of roses, the heavily scented oil (used in making perfume) extracted from them, is one of the country's principal products, and an important export. This area also produces tobacco (chief article of export), fruits, sugar-beet, rice, and cotton. Other exports are wines and spirits, lead concentrates, lamb hides, and tomato pulp.

Both the Balkan range in the central area and the Rhodope mountain chain in the south-west are heavily wooded. The Balkan Mountains are thinly peopled, though they include fertile valleys and pasture lands. There are minerals, notably coal, copper, lead, and zinc, but mining could be much increased.

The Bulgarians of to-day are descendants of the Bolgars, a people akin to the Huns, who came from the Volga plains and settled in this region towards the close of the 6th century, succeeding in detaching it from the Byzantine Empire. After a time they became completely merged with the Slavs they found living there, and developed a powerful state which was, however, ultimately re-absorbed in the Byzantine Empire from 1018 to 1186. After another period of independence the country of the Bulgarians was conquered by the Turks and endured five centuries of oppressive Turkish rule (1396–1878).

A revolt which broke out in 1876 was put down with such cruelty that Russia went to war with Turkey on behalf of the Bulgarians. The victorious Russians dictated a harsh treaty, revised by the Great Powers of Europe in a conference at Berlin (1878). Bulgaria emerged as a self-governing principality only nominally subject to Turkey. In 1908 the country declared itself independent, with the reigning Prince Ferdinand (1861–1948) as Tsar.

The frontiers established by the Treaty of Berlin left large numbers of Bulgarians in other lands, especially in Macedonia (then Turkish). Serbia and Greece also laid claim to parts of Macedonia, and in 1912 Bulgaria, Serbia, Greece, and Montenegro declared war on Turkey. Turkey was defeated and forced to surrender almost all her European territory to the allies, Bulgaria receiving the lion's share. Immediately there was trouble over the spoils, and soon Bulgaria was at war with her former allies. This war was disastrous to Bulgaria, for the southern Dobruja was lost to Rumania, and Macedonia was divided between Greece and Serbia. Bulgaria was smarting under this humiliation when the First World War broke out. In 1915 she entered the struggle on the side of Germany and Austria, and, sharing their defeat in 1918, was condemned by the Treaty of Neuilly to pay a heavy indemnity, and was disarmed and stripped of more of her territory. Ferdinand abdicated, and was succeeded by his son Boris III (1894–1943). Boris cemented a growing friendship between his country and Italy by his marriage in 1930 to an Italian princess.

During the Second World War, Bulgaria tried to keep on good terms with both sides. She signed the "Axis" pact in March 1941, and in December declared war on the United Kingdom and the U.S.A. (but never on Russia). She allowed the Germans to use her territory as a base for attacks on her neighbours, but she herself did no fighting until in 1944 Russia declared war on her, and the Allies compelled her to agree to an armistice by which she had to fight with them against the Germans. When the peace treaty between Bulgaria and the Allies was signed in 1947, she had to give up parts of Yugoslavia and Greece that she had occupied with German consent, but the treaty signed at the same time with Rumania confirmed Bulgaria in possession of the southern Dobruja, which Germany had forced Rumania to give her in 1940.

In 1946 Bulgaria became a Communist state and a Soviet satellite, and the young King Simeon II (b. 1937) was exiled with his mother. Georgi Dimitrov, the first Communist Premier, died in June 1949, and his deputy, Kostov, was hanged the following December for political "crimes." It is still not easy for westerners to get detailed information, but the collective farm system, which was at first very unpopular, appears to be widely established. Some industries, including textiles, are being developed, and some country districts have benefited from electrification schemes. Oil was discovered on the Black Sea coast, near Varna, in 1952.

Bull-fighting. Designs on vases and frescoes, unearthed in Crete and other Mediterranean lands, show that in those regions there have been played for 5,000 years games in which young men, and sometimes girls, pitted their courage and skill against the strength of a fighting bull. Exactly similar games are still played to-day —as, for instance, pole-vaulting over the charging animal, which may still be seen in southern France.

MATADOR DRESSED TO KILL

The man who has the task of actually killing the bull is the matador (or torero), who wears a satin suit, embroidered with silver and gold lace, and a black velvet hat. With the cape he "plays" the charging bull.

In Spanish villages, too, such games are practised; but the Spanish bull-fight, in which the bull is killed at the end of a highly-developed ritual, is much more than a game. Most towns of any size have a bull-ring. The bulls, which are bred specially for fighting, are lighter than British breeds, but fiercer and much more active. The matadors—the men who do the actual killing—are national heroes, and may earn huge salaries. Manolete, a famous modern bull-fighter, who died in 1947 at the age of 30, after being gored by a wounded bull, was said to earn £500,000 a year.

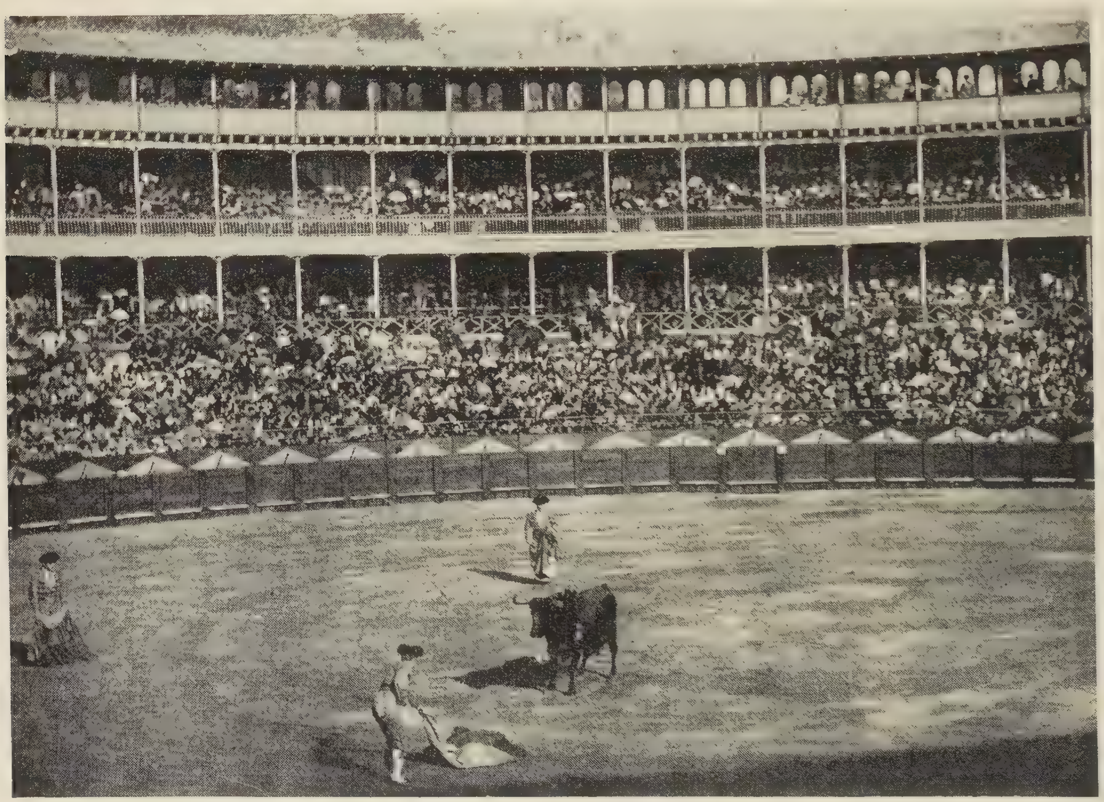
Although the matador of to-day is a professional, Spanish bull-fighting was the sport of the aristocracy until the 17th century. It is thought to have been introduced by the Moors, and according to popular tradition the first Spaniard to kill a bull in the ring was their great 11th-century hero, the Cid (or lord), otherwise Rodrigo Diaz de Bivar (?1040–99), who thereby proved himself better than the Moorish knights.

Until the 18th century the bull was killed from horseback, with a lance, but to-day the matador fights on foot with a sword, the mounted picador playing a lesser part in the proceedings.

The bull-fight is called a *corrida*, and as a rule six bulls are killed. The bull-ring is an open sand-covered area, surrounded by a high fence. Between fence and spectators is a narrow passage-way where the bull-fighters wait. There are usually two or three matadors, who take the bulls in turn. Each has his own team of picadors, banderilleros, and other assistants. The *corrida* begins with a magnificent procession of all the bull-fighters round the arena. The matadors wear satin suits richly embroidered with gold and silver, and their special parade capes. The picadors usually wear yellow. At the end of the procession is the gaily-decorated mule-team that drags off the dead bulls. The president of the *corrida* then throws down the key to the bull-pen. The door is opened and the first bull rushes in.

The fight is a three-act drama, and Act 1 presents the mounted picadors. Until quite recently the horses used to become terribly gored, but the law now demands that they should be padded. Men with capes direct the bull's charge towards a picador, who must try to plant his lance behind the animal's neck. This helps to limit the sideways sweep of the horns. If the picador is unseated, the bull's attention is diverted with capes. (Though the capes are red, it is a popular mistake to suppose that red is especially exciting to bulls. Any bright colour would do. It is the waving about that infuriates the animal.)

When the bull has been "pic"-ed several times—the matador meanwhile watching all its tricks of behaviour, to judge how best to handle it at the climax—there follows the act of the banderilleros. These work on foot, and each has



TEASING THE BULL WITH A RED CLOAK

With barbed darts hanging from his shoulders, the bull faces the man with the cape, who is endeavouring to make him charge. Each phase of a bull-fight is part of a plan. Overthrowing the horsemen tires the bull's neck and shoulder muscles; and his onslaughts upon the red cape tire him still further. He stands with head held low as the matador advances to make the kill, thus exposing the spot between the shoulder-blades where the sword will enter.

Ian M. Thomson

PAIR OF BULLFINCHES ON THEIR NEST

Here the photographer has " caught " both parent birds at the nest, which is constructed of twigs, rootlets, and hair and often also of a little wool. Bullfinches usually build their nest during May in a hedge or bush. The four or five pale blue eggs are streaked with purplish markings. The cock bird has a rose-red breast, black head, and blue-grey back. The female is duller, with pinkish-grey breast. Their food consists of weed-seeds, berries, and buds.

three minutes in which to plant his pair of *banderillas*—long, barbed darts—on either side of the bull's neck. Usually four pairs are planted.

The last act is the killing. The matador, alone, stands before the president, holding aloft in his left hand his sword and *muleta* (a piece of red cloth spread over a stick), and his hat in his right hand. With solemn formality he dedicates the death of the bull to the president or some other notability, tosses his hat behind him, and advances bare-headed. With the *muleta* he brings the head and hoofs of the bull into a position where he can best administer the death-stroke between the shoulder-blades. His aim is to kill the tired bull with a single stroke—but often enough the matador himself is the victim.

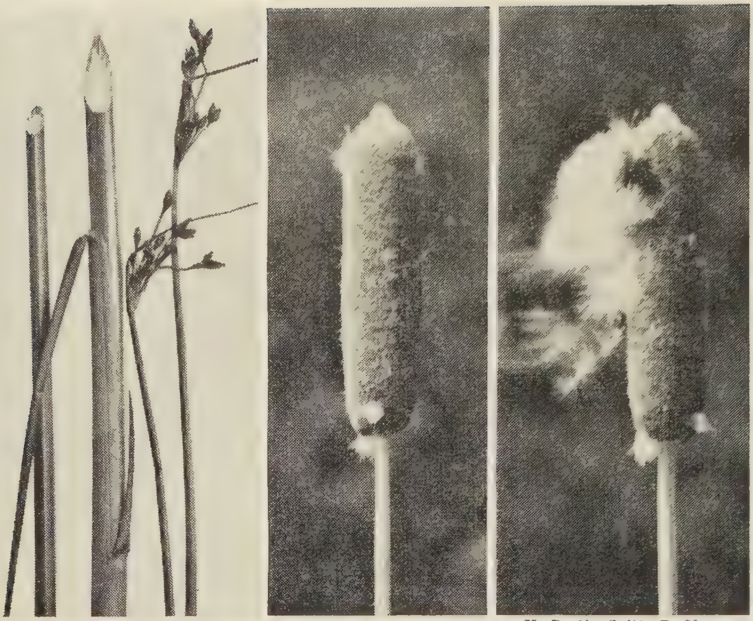
Bull-fights in Spanish America follow the Spanish pattern, but in Portugal the bull is not killed. Its horns are padded, and the great feature of the contest is the display of horsemanship. After several pair of *banderillas* have been planted, from horseback, the men overthrow the bull by seizing its horns and leaping on its back, as in some of the ancient bull games. In southern France the popular sport is to snatch a cockade of ribbons from between the bull's horns. Here again the bull is not killed—though its challenger may be—and a really cunning bull may succeed in keeping its cockade unplucked through a number of seasons.

The Madrid bull-fighting season is from Easter to November, with fights every Sunday, sometimes on Thursdays also, and often on saints' days. In the smaller towns and cities of Spain fights take place at irregular intervals, often coinciding with saints' days or fairs.

Bullfinch. Thought by many to be the most beautiful British finch, this bird is at once distinguishable from the others by the black cap, wings, and tail. The back is grey and the bill comparatively thick and robust. Sexes differ in that the cock has the breast and underparts bright rose-red whereas in the hen they are only pinkish-grey. Each, however, has a pure white rump (this, in birds, being that portion on the upper side of their bodies above the tail) and this feature is a sure clue to the bullfinch's identity. A resident bird, the British Bullfinch, to use the correct name, is somewht shy and secretive in its habits. It generally avoids the open whenever possible, haunting woods, gardens, and thickets, where it lives on buds, seeds, and berries. The cock and hen are rarely far apart and one often meets them in pairs piping their way through copses or from hedgerow to hedgerow. The scientific name of the bird is *Pyrrhula pyrrhula nesa.*

Bulrush. This name is very commonly given in error to the striking-looking reed mace, which grows about five feet high, with a flowering head like a brownish-black candle some nine inches long. Strictly speaking, the bulrush is a plant quite different as regards its flower, which appears in red-brown clusters on small branches at the summit of the stem. The true bulrush grows to about eight feet high. Both these perennial plants are used for making rush-bottoms for chairs, mats, bags, and baskets, and for thatching.

Both the reed mace, often called the great bulrush or cat's tail, and the true bulrush, occur in Great Britain. They grow in or beside ponds and streams, and sometimes in marshy districts. The scientific name of the true bulrush is *Scirpus*



H. Bastin (left); R. Moore

BULRUSH AND REED MACE

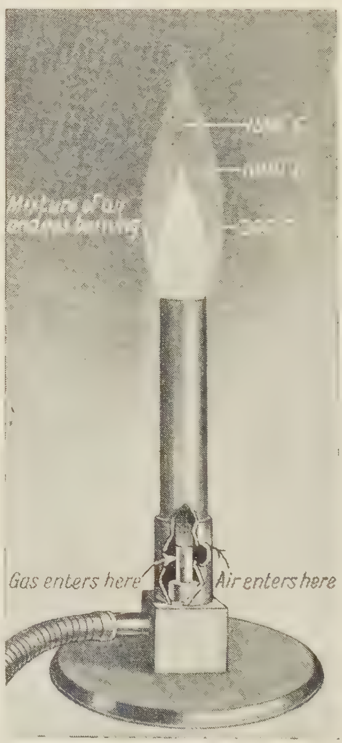
The true bulrush is a sedge (left), which grows beside and in streams. It has loose clusters of small flowers. The reed mace, sometimes incorrectly called the great bulrush, has a brownish-black spike (centre) of flowers which later become fluffy-winged seeds to be scattered far and wide by the wind (right).

lacustris, and the plant is a member of the sedge family (*Cyperaceae*). The reed mace is *Typha latifolia*, family *Typhaceae*.

Bunsen, Robert Wilhelm Eberhard (1811–99). When gas was first used for lighting and heating, the flame was hardly more powerful than that of a candle. This was because it was burning only in the pressure of air; and to increase its heat and light it was necessary to make the flame heat a kind of hood of gauze placed over it. In fact, it was not until the German chemist Robert Bunsen thought of burning air that gas became an efficient source of heat and light.

In 1853 Sir Henry Roscoe (1833–1915), a British scientist, visited Heidelberg, Germany, where Bunsen was chemistry professor at the University. Roscoe complained to the German chemist about the poor light and heat from gas. Bunsen thought for a while and then said: "I think that the problem could be solved by burning a mixture of gas and air." Two years later he introduced the gas burner, which worked on the principle by which gas is now used in stoves and lights.

Bunsen found that if more oxygen (or air) were supplied to a gas flame, most of its brightness was lost, because all the carbon could burn up. In this way more perfect combustion resulted, while the non-luminous flame was much hotter and was smokeless.



BUNSEN BURNER

In the Bunsen burner air mixes with gas, as shown, to produce a very hot flame. This principle is also used in the incandescent gas burner and the common gas ring.

The Bunsen burner of today consists of a hollow metal tube. One end, the flame end, is open, while the other has an air-hole close to the part where the tube is joined to the gas supply. As the gas enters the tube from the bottom, air is drawn in through the hole, because, as the gas is at a higher pressure than that of the outside atmosphere, a state of low pressure is created in the tube. Air must therefore rush in to equalise the pressure inside and outside. Inside the tube the air and gas mix together, and when the mixture is lighted at the open end it burns in the form of two cones.

The inner cone consists of a partly-burnt mixture of gas and air, and burns with a green colour, while the outer cone is almost colourless except for a slightly purple tinge at the edges. The hottest part is the outer edge of the outer cone.

If the flame from a Bunsen burner has a yellow tip, it means that the proportion of gas to air is wrong and that the mixture is not burning as hotly as it should. If not enough gas is entering the burner, the flame may pass down the tube and burn close to the air-hole. When a gas mantle is suspended over a Bunsen burner, the mantle becomes white hot and gives a brilliant, clear light.

Bunting. The commonest and consequently best-known bird of this group is the Yellow Bunting, familiar to many by its local name of Yellowhammer and to the ornithologists by its scientific name, *Emberiza citrinella citrinella*. It is about as big as a house-sparrow but conspicuous by the amount of bright yellow in its plumage.

In spring and early summer the cock bird enlivens the gorse patches of the open countryside with his characteristic little song composed of a number of short notes followed by a long one higher in the scale; and this has been likened by poets and others to the phrase "A little bit of bread and no *cheese*."

The corn-bunting, *Emberiza*

calandra, is larger and stouter, its dull brown, streaked plumage having no conspicuous markings. The cock bird's very short explosive song, often from some prominent perch, is the best guide to its presence in any locality.

The cirl bunting, *Emberiza cirlus cirlus*, is a British resident but very locally distributed, nesting here and there in southern England and parts of Wales. Its plumage is similar to that of the yellow bunting, but the cock has a black throat.

The reed-bunting, *Emberiza schoeniclus schoeniclus*, similar in size to the others, haunts fens, reed-beds, and vegetation in the neighbourhood of water. The cock's black head and throat and white collar are distinguishing features. The hen is more soberly coloured.

All these buntings nest on or near the ground, their eggs being greyish with peculiar dark streaks as though someone had scribbled on them with a pen. This has led, in many parts of the countryside, to reference to the commoner British buntings as "writing larks" or "scribbling larks."

Eric Hosking

CORN BUNTING ON HER NEST

This female corn bunting is a member of a group of small birds allied to the finches. It is about seven inches long, and has dull brown plumage. The nest of grass, moss, and hair is built on the ground or in a bush.

The INSPIRED TINKER *of* ELSTOW

Bunyan, John (1628–88). "A tinker out of Bedford, a vagrant oft in quod, a private under Fairfax, a minister of God"—that was how the poet Kipling described the man who wrote the immortal *Pilgrim's Progress*. Bunyan, born at the village of Elstow, near Bedford, became, like his father, a tinker, a mender of metal pots and pans; and during the Civil War of 1644–48 he fought for a time in the Parliamentary army under General Fairfax. Later he spent over 12 years of his life in prison.

The reason for his imprisonment was simply that after the Civil War he became deeply interested in religion, joined the newly-arising sect of Baptists, and began to preach to the poor people in and around Bedford. In those days of bitter religious strife such preaching was unlawful, and he was therefore sent to prison in 1660. He was constantly told that he would be set free if he would agree to give up his preaching, but he replied: "If you let me out to-day, I will preach again to-morrow." While in prison, he supported his wife and family by making shoelaces, and passed the rest of his time in reading the Bible and preaching to other prisoners—and in writing books. He wrote three books while a prisoner: *The Holy City, or The New Jerusalem* (1665), *Grace Abounding* (1666), and *Defence of the Doctrine of Justification by Faith* (1672). *Grace Abounding* is the story of his own early life.

He was released in 1672, resumed his preaching, and was again jailed for six months, and then set free because the Declaration of Indulgence in that year at last allowed Baptists to worship in their own meeting-houses under their own ministers. He spent the rest of his life as a regular Baptist minister, though he died in London and was buried there, in the Nonconformist burial ground at Bunhill Fields. There is now a statue of him at Bedford, another, by Richard Garbe, R.A. (1876–1957), on the wall of the Baptist Church House in Southampton Row, London, and a window in Westminster Abbey dedicated to his memory.

It was during his second short period "in quod" that Bunyan began to write *The Pilgrim's Progress*. When it was published, in 1677, the book at once became famous. It is believed that 100,000 copies were sold during his lifetime. In 1680 it was reprinted by the Puritan colony in America, there receiving, as Bunyan himself wrote, "much loving countenance." Since then it has been translated into nearly 150 languages, including Eskimo and Tibetan. Among devotional books, it may claim a popularity comparable only with that of *The Imitation of Christ*, by the German monk, Thomas à Kempis (see article.)

Why was it, and why does it remain, so greatly loved? The main reason is that it tells a simple story that everyone can follow, in simple language that everyone can understand. The language is closely akin to that of the Authorised Version of the Bible, and in Bunyan's own day that was the book which all English people knew best. Even people who could scarcely read at all managed somehow to read their Bibles. Then again, the story itself is exciting. No one who reads it can fail to be eager to know what happens to the hero in the end, after all his adventures and mis-

adventures, his fights and his perils, his high hopes and his bitter disappointments.

The Pilgrim's Progress is an allegory ; that is to say, all the people, places, and episodes in the story, however interesting they may be in themselves, have a second and deeper meaning—in a word, they are symbols, like the animal characters in Aesop's Fables. This is made clear by the names that Bunyan chose for his people and places. What he is really describing is the struggle of every Christian soul in search of divine salvation. So he called his hero Christian, and other characters in the book are given such names as Mr. Legality, Mr. Worldly Wiseman, Obstinate, Pliable, Watchful, Faithful, and Hopeful. In the second part of the book (published 1684) we are introduced to Mr. Great-heart, Mr. Valiant-for-truth, Mr. Feeble-mind, Mr. Despondence, and Mr. Ready-to-Halt. Place-names include the Slough of Despond, the village of Morality, the Hill of Difficulty, the Palace Beautiful, the Valley of Humiliation, and Doubting Castle, the home of Giant Despair. Best known of all, perhaps, is the town of Vanity, because here was held the famous Vanity Fair. The meaning of the allegory, indeed, is so clear that any child can follow it, even while he is enjoying the story for its own sake.

Bunyan's other books, much less well known, were *The Life and Death of Mr. Badman* (1680) and *The Holy War* (1682). The latter work describes the attempt by the Devil to capture the city of Mansoul (man's soul), which is defended by the good angels. It contains thrilling descriptions of battles that show Bunyan to have had a detailed knowledge of the craft of warfare.

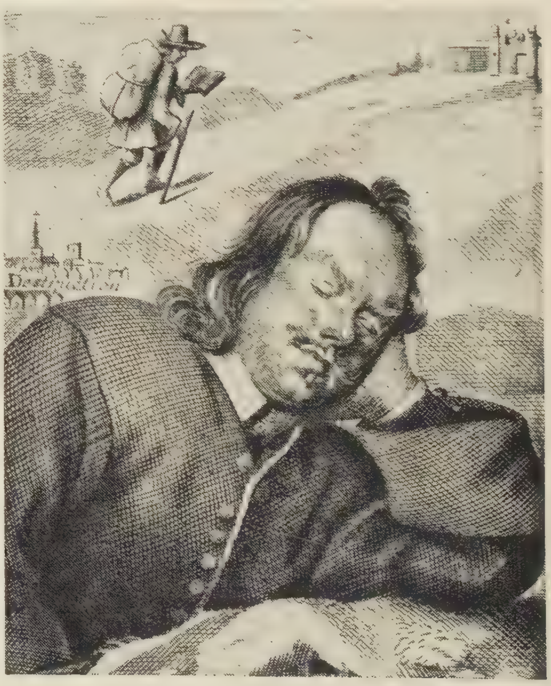
We reprint here three passages from *The Pilgrim's Progress*. The resemblance of Bunyan's style to that of the Bible will be obvious to every reader. The second and third extracts are from the second part. The verses beginning " Who would true valour see " form one of the many songs scattered through the story. A garbled version of this song is printed in some modern hymn-books and is commonly referred to as " Bunyan's hymn " ; but Bunyan's own words are far more sturdy and stirring.

I. IN THE GRIP OF GIANT DESPAIR

Now there was, not far from the place where they lay, a castle called Doubting Castle, the owner whereof was Giant Despair, and it was in his grounds they were now sleeping ; wherefore he, getting up in the morning early, and walking up and down in his fields, caught Christian and Hopeful asleep in his grounds. Then with a grim and surly voice he bid them awake, and asked them whence they were, and what they did in his grounds. They told him they were pilgrims, and that they had lost their way. Then said the giant, You have this night trespassed on me by trampling in and lying on my ground, and therefore you must go along with me. So they were forced to go, because he was stronger than they. They also had but little to say, for they knew themselves in a fault. The giant, therefore, drove them before him, and put them into his castle, into a very dark dungeon, nasty, and stinking to the spirits of the two men. Here, then, they lay from Wednesday morning till Saturday night, without one bit of bread or drop of drink, or light, or any to ask how they did ; they were, therefore, here in evil case, and were far from friends and acquaintance . . .

Now Giant Despair had a wife, and her name was Diffidence ; so when he was gone to bed, he told his wife what he had done, to wit, that he had taken a couple of prisoners, and cast them into his dungeon for trespassing on his grounds. Then he asked her also what he had best to do further to them. So she asked what they were, whence they came, and whither they were bound, and he told her. Then she counselled him, that when he arose in the morning he should beat them without mercy. So when he arose, he getteth him a grievous crabtree cudgel, and goes down into the dungeon to them, and there first falls to rating of them as if they were dogs, although they gave him never a word of distaste. Then he falls upon them, and beats them fearfully, in such sort that they were not able to help themselves, or to turn them upon the floor. This done, he withdraws and leaves them there to condole their misery, and to mourn their distress ; so all that day they spent the time in nothing but sighs and bitter lamentations. The next night she, talking with her husband about them further, and understanding that they were yet alive, did advise him to counsel them to make away themselves. So when morning was come, he goes to them in a surly manner, as before, and perceiving them to be very sore with the stripes that he had given them the day before, he told them, that since they were never like to come out of that place, their only way would be forthwith to make an end of themselves, either with knife, halter, or poison ; for why, said he, should you choose life, seeing it is attended with so much bitterness ? But they desired him to let them go. With that he looked ugly upon them, and rushing to them had doubtless made an end of them himself, but that he fell into one of his fits (for he sometimes, in sunshiny weather, fell into fits) and lost for a time the use of his hands ; wherefore he withdrew and left them as before to consider what to do . . .

Well, towards evening the giant goes down into the dungeon again, to see if his prisoners had taken his



BUNYAN'S DREAM

In the frontispiece to the fourth edition (1680) of *The Pilgrim's Progress,* shown here, John Bunyan, is pictured dreaming of Christian's journey from the City of Destruction to the Celestial City.

By the 19th-cent. artist Fred. Barnard

GIANT DESPAIR OF THE CASTLE

When Christian and his comrade, Hopeful, neared the end of the journey to the City of God they were seized by Giant Despair and imprisoned in his castle.

counsel. But when he came there, he found them alive, and truly, alive was all; for now, what for want of bread and water, and by reason of the wounds they had received when he beat them, they could do little but breathe. But I say, he found them alive; at which he fell into a grievous rage, and told them, that seeing they had disobeyed his counsel, it should be worse with them than if they had never been born. . . .

Now night being come again, and the giant and his wife being in bed, she asked him concerning his prisoners, and if they had taken his counsel; to which he replied, They are sturdy rogues; they choose rather to bear all hardships than to make away themselves. Then said she, Take them into the castle-yard to-morrow, and show them the bones and skulls of those that thou hast already despatched, and make them believe, ere a week comes to an end, thou also wilt tear them in pieces, as thou hast done their fellows before them.

So when the morning was come, the giant goes to them again, and takes them into the castle-yard, and shows them as his wife had bidden him. These, said he, were pilgrims, as you are, once, and they trespassed in my grounds as you have done; and when I thought fit I tore them in pieces, and so within ten days I will do you; get you down into your den again. And with that he beat them all the way thither. They lay, therefore, all day on Saturday in lamentable case, as before.

Well, on Saturday, about midnight, they began to pray, and continued in prayer, till almost break of day.

Now a little before it was day, good Christian, as one half amazed, brake out in this passionate speech; What a fool, quoth he, am I, to lie in a stinking dungeon, when I may as well walk at liberty! I have a key in my bosom, called Promise, that will, I am persuaded, open any lock in Doubting Castle. Then said Hopeful, That's good news; good brother, pluck it out of thy bosom, and try.

Then Christian pulled it out of his bosom, and began to try at the dungeon door, whose bolt, as he turned the key, gave back, and the door flew open with ease, and Christian and Hopeful both came out. Then he went to the outward door that leads into the castle-yard, and with his key opened that door also. After that he went to the iron gate, for that must be opened too; but that lock went desperately hard, yet the key did open it. Then they thrust open the gate to make their escape with speed; but that gate, as it opened, made such a cracking, that it waked Giant Despair, who hastily rising to pursue his prisoners, felt his limbs to fail; for his fits took him again, so that he could by no means go after them. Then they went on, and came to the King's highway, and so were safe, because they were out of his jurisdiction.

II. THE SHEPHERD BOY'S SONG

NOW as they were going along and talking, they espied a boy feeding his father's sheep. The boy was in very mean clothes, but of a very fresh and well-favoured countenance; and as he sat by himself he sang. Hark, said Mr. Great-heart, to what the shepherd's boy saith. So they hearkened, and he said,

He that is down needs fear no fall;
  He that is low, no pride:
He that is humble ever shall
  Have God to be his guide.

I am content with what I have,
  Little it be or much;
And, Lord, contentment still I crave,
  Because Thou savest such.

Fulness to such a burden is,
  That go on pilgrimage:
Here little and hereafter bliss,
  Is best from age to age.

Then said their guide, Do you hear him? I will dare to say that this boy lives a merrier life, and wears more of that herb called heart's ease in his bosom, than he that is clad in silk and velvet.

III. THE SONG OF MR. VALIANT-FOR-TRUTH

WHO would true valour see,
  Let him come hither;
One here will constant be,
  Come wind, come weather;
There's no discouragement
Shall make him once relent
His first avowed intent
    To be a pilgrim.

Whoso beset him round
  With dismal stories,
Do but themselves confound;
  His strength the more is.
No lion can him fight,
He'll with a giant fight,
But he will have a right
    To be a pilgrim.

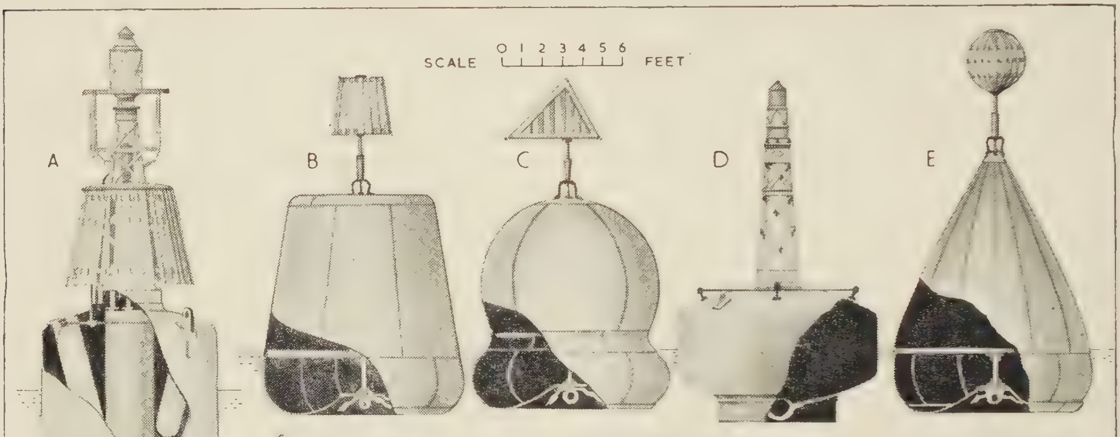
Hobgoblin nor foul fiend
  Can daunt his spirit;
He knows he at the end
  Shall life inherit.
Then fancies fly away,
He'll fear not what men say;
He'll labour night and day
    To be a pilgrim.

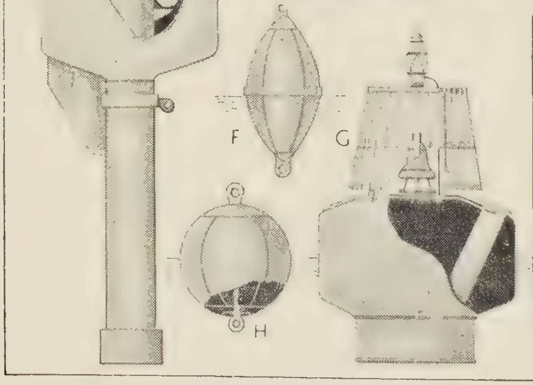
Buoy. A buoy is a seamark (not to be confused with a life-buoy, which is carried on board ship and thrown to the help of a man overboard). Buoys have been used for marking dangerous shoals and reefs, or safe channels, since the days of

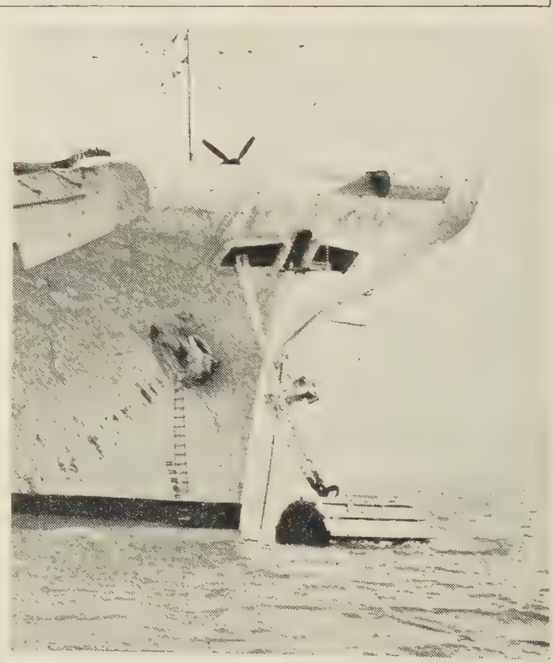
Henry VIII at least, and probably before that. The early ones were no more than empty barrels. Until recently they were of bewildering variety in shape and painting. An officer or pilot who could remember the particular buoy he was passing knew exactly where he was. Nowadays nearly all are conical (pointed), can (tapering towards the top), or spherical like a huge ball in the water. All countries have adopted a uniform system, and all the buoys for a particular purpose have the same shape and colouring, although the name is painted on the side, and, if they are lighted by compressed gas, the flashes at intervals are characteristic. Those marking the sides of a deep-water channel differ in shape and painting according to their position on the port or starboard side coming in, and if they are lighted the arrangement of their flashes cannot be mistaken. Those marking the middle of the channel float low in the water and have a pole or lattice mast over them. Where confusion is possible, buoys have a distinguishing mark on top.

Dangerous shoals or reefs are marked by spherical buoys placed at the end of the danger; their colours show on which side the safe channel lies. Wrecks on which ships may tear big holes in their bottoms are marked by buoys painted green—conical, can, or spherical. Many buoys are lighted by gas, and the books carried on board of every ship give the exact character of each light. Others ring a bell as they roll with the waves or sound a mournful whistle, but they do not operate, of course, in calm weather or in rivers. Some of the biggest buoys at important positions are fitted with an automatic fog-bell operated by compressed carbon dioxide gas pressure. Such fog-bells do not depend on motion of the waves and always sound, even in a calm sea.

Buoys, like other objects, reflect radar rays sent out by a ship's radar set, and the reflected rays are picked up by the ship's special receiver, which translates them into picture form and gives a display of the panorama around the ship. The distance at which buoys may be picked up by radar

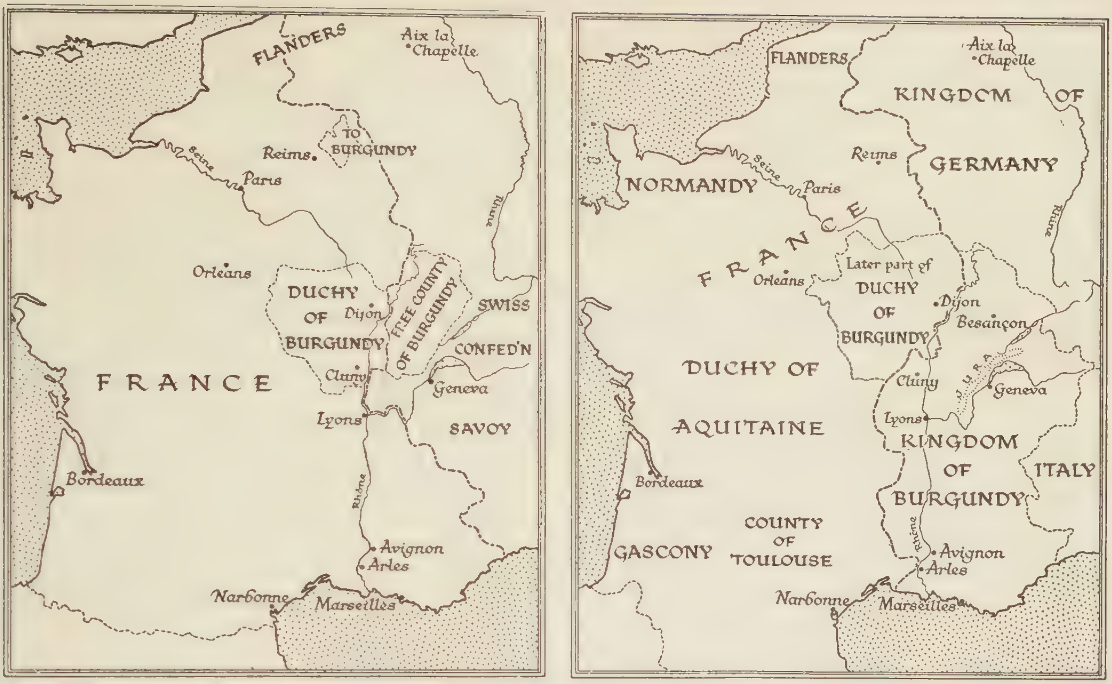






BUOYS THAT SIGNPOST THE SEA

Here various kinds of buoys are shown. A. Whistling buoy with light. B. One type of can buoy. C. Spherical buoy. D. Low pillar buoy with light. E. Conical buoy. F. Wreck buoy, painted a bright emerald green. G. Acetylene gas buoy. H. Mooring buoy. On the right is another type of mooring buoy used by big vessels. Mooring buoys have no distinctive shape or colouring, but have to be securely attached to the bottom. Spherical buoys mark dangerous reefs or shoals; conical, can, or spherical buoys mark wrecks. Others ring a bell as they roll, or carry an automatic fog-bell.



BURGUNDY : NAME OF A KINGDOM, DUCHY, AND FREE COUNTY

In the map on the right the boundaries of the Kingdom, founded A.D. 937, are shown. The Free County of Burgundy, shown in the map on the left, was part of the Holy Roman Empire until 1384, when it was joined to the Duchy.

can be increased by fitting radar reflectors on the tops of the buoys. This is most valuable in darkness for unlighted buoys and for both lighted and unlighted buoys in fog.

Buoys are also useful for various purposes other than as seamarks. Those used for mooring ships have no distinctive shape or colouring but have to be very securely attached to the bottom. The fisherman uses a Dan buoy to show the position of his net. In making charts of the sea bed they are temporarily laid in various places so that the surveyors can make each sounding in exactly the right place.

Burgundy, France. To those who are not Frenchmen, the province of Burgundy is now chiefly remarkable as a district from which come some of the most famous French wines. Before the Revolution, Burgundy, lying between the heart of France and the Swiss frontier, was the area now occupied by the departments of Jura, Doubs, Belfort, Haut Saône, and parts of Ain, Saône et Loire, and Côte d'Or ; but that area was only the latest shape of the Burgundia, Bourgogne (boorgon'*ya*), or Burgundy whose borders had shifted and spread and contracted on both sides of the Jura mountains for thirteen hundred years.

The Burgundians formed one of the groups of tribes (others were the Goths and Franks) which overran the Western Roman Empire soon after A.D. 400. Their last home east of the Rhine was around Worms ; their defeat about 436 by Attila and his Huns was dimly reflected in the Middle Ages by the mixture of Norse myth and German legend which poets and singers wove into the story of the Nibelungs (*see* Nibelungs, Song of The). In that grim tale of treasure and revenge and battle the hero Siegfried is murdered by the Burgundian warrior Hagen.

The historical Burgundians were said by the Roman-Gaulish writer Sidonius Apollinaris (*c.* 431–*c.* 484) to be many of them seven feet tall. They invaded Alsace, were beaten by the Romans and given lands for settlement in Savoy, and there set up a kingdom which at one time included the western half of Switzerland and the valleys of the Saône and Rhône. Defeated again by the Franks, who made them into subject allies, the Burgundians formed a loyal element in the empire of Charlemagne. Under his successors that empire fell apart. Burgundy reappeared as a separate kingdom (called the kingdom of Arles from its chief city, which was actually in Provence), until in 1032 its last king bequeathed his territories to the emperor. Two great movements of church reform began in Burgundy ; the Cluniac Order was founded at the abbey of Cluny in 910, the Cistercian Order at the abbey of Cîteaux in 1098.

Burgundy west of the Jura mountains soon began to be absorbed by the rising power of the kingdom of France, of which it became a duchy. The eastern part, called the Free County (*Franche Comté*), remained within the Empire until 1384, when it passed by marriage to the French duke, who thus became the most powerful subject of his elder brother the French king. For a century Burgundy was an almost or a quite independent power ; the quarrels of its dukes with their French kinsmen helped to cripple France during the second half of the Hundred Years' War. When at length the English had been driven out of France, the last ruling duke of Burgundy, Charles the Bold, proved no match in statecraft for the French king

Louis XI; and when in 1477 Charles fell in battle against his rebellious Swiss subjects, Burgundy was again divided, the Free County going back to the Empire as part of the inheritance of Charles's daughter Mary, who married the Emperor Maximilian. It was once more ceded to France in 1679. By then the title of Duke of Burgundy had been revived by Louis XIV for his grandson Louis, father of the prince who succeeded to the French throne as Louis XV.

Burke, EDMUND (1729–97). Before the War of American Independence (1775–83), during a bitter debate in the British House of Commons over the question of taxing the American colonies, one of the members hotly asked: "Should not America belong to this country?" A calm clear voice replied: "If we have equity, wisdom, and justice, it will belong to this country; if we have not, it will not belong to this country."

The voice was that of Edmund Burke, and his words were prophetic; for if Britain had adopted the wise and moderate policies which he advocated, the history of America would probably have been very different. Again and again this Irishman rose in Parliament and fought, now with all the warmth of his passionate sense of right, now with the cold penetrating strength of his logic, for the principles of justice and liberty as he believed they applied to the great questions of the day.

Born in Dublin, and educated there at Trinity College, Burke came to London to study law. His *Philosophical Inquiry into the Origin of our Ideas on the Sublime and Beautiful* (1756) brought him

From the portrait by John Hoppner, R.A.

EDMUND BURKE

This statesman was an ardent advocate of liberty. He opposed the harsh rule which George III wished to impose on the North American colonies, but he equally detested the excesses of the French Revolution.

recognition as a philosophical writer, and he became a member of the famous Literary Club of which Dr. Samuel Johnson was leader. He was soon supporting himself by his pen, notably by his yearly review in the *Annual Register*.

In 1765 he became private secretary to Lord Rockingham, the Whig prime minister of the day, and was elected to Parliament. Though Burke never held high office he became prominent because of his wide knowledge, his penetrating judgment, and his brilliant oratory. As an orator he lacked the magic and majesty of some of his great contemporaries. But as a writer on politics he was supreme. His published speeches, and his political writings—of which the speech *On Conciliation* (1775), *Letter to a Noble Lord* (1796), and *Letters on a Regicide Peace* are outstanding examples—reveal him as one who knew the art of exploiting the sonorous richness of the English language in the cause of reasoned argument.

Although he was usually on the losing side, his influence on the general trends of political thought in his time was considerable. After his unsuccessful struggle on behalf of the American colonists he came forward as the champion of the peoples of India. He moved the impeachment of Warren Hastings, the Governor-General of India, whom he charged with plundering the hapless natives. Although Hastings was acquitted, and many now believe that Burke was mistaken in his judgment, his powerful speeches drove home the lesson that the rights of a subject people must be respected.

When Burke later came out in opposition to the French Revolution, many of his former political friends regarded him as a turncoat, for now he seemed to have abandoned the cause of liberty. But Burke had before argued only for the rights of the individual as against an unjust government. He was essentially a Conservative and never a believer in "government of the people, by the people, for the people"; thus he persistently opposed the reform of Parliament. Liberty, he held, is "inseparable from order"; and the lawlessness and bloodshed of struggling democracy in France so aroused his ire that he could see no good in it. His views were expressed in a pamphlet entitled *Reflections on the Revolution in France* (1790). His attitude to the movement across the English Channel completed his breach with the Whig party; but he was made much of by the Court and the Tories. George III wished to honour the champion of the old order by making him a peer; but before the title was conferred Burke suffered a blow which took from him all ambition for honour. He lost his only son, whom he loved deeply. A pension was all he would accept. Retiring from Parliament in 1794, he died three years later and was buried at Beaconsfield, Buckinghamshire.

Burma. This land of golden pagodas is a corner of Asia which lies east of India and Pakistan and west of China and Siam. Forming a part of the sub-continent of Indo-China, Burma has been the meeting place of two of the world's oldest civilizations—India and China. Now an independent republic, Burma was from 1886 to 1937 a province of British India, after which it became a separate country but still within the British Commonwealth until 1948.

Capt. H. T. Parry

BURMESE LEG-PADDLERS TOW THE STATE BARGE

At the great water festival of Yawnghwe, a Burmese celebration in honour of Buddha, a barge is towed along the lake by a crew of Inthas in their own peculiar manner. Each man crooks his leg round his paddle, and the boat is thus propelled through the water by the action of their legs, while a boy in the bows beats time for the rowers with his cymbals. Most Burmese are Buddhists, and they have preserved the teaching of Buddha in its purest form.

It is a colourful country, with dense jungles in which roam hordes of elephants, tigers, wild boar, bears, deer, and fierce wild cattle. Here also can be found highly-coloured birds, poisonous snakes, and hosts of insects. There are few large towns, and these are found in the river valleys which form the chief lines of communication.

Rangoon (the capital), Mandalay, and Moulmein are the three largest cities. Except in the north, where the mountains are a continuation of the high plateau of Tibet, the mountain ranges run from north to south and the river valleys lie between them. Burma's largest river, the Irawadi, rises in Tibet and flows through two-thirds of the country's length. Its largest tributary, the Chindwin, joins it just below Mandalay, the capital of the last Burmese monarch. This city is the heart of Burma, for here can be found all the symbols of the country's ancient system, political, social, and educational. The delta of the Irawadi is a fertile area of 10,000 square miles, and is one of the greatest rice-producing regions in Asia. Other large rivers are the Sittang, whose tidal waves make it unsuitable for navigation, and the Salween; both of these flow into the Gulf of Martaban. Covering a total of 262,000 square miles, Burma has a population of nearly 18 millions.

Formerly the largest rice-producing country in Asia, Burma also has great mineral wealth and other natural resources. Its vast forests have unlimited supplies of teak and other hardwoods. Trees are cut down and shaped into logs, which are carried by trained elephants to the rivers. The logs are then tied in rafts and floated down the rivers to sawmills in the towns at their mouths. Oil is found in central Burma, and scattered in the mountains of the north are silver and lead, copper and tungsten (wolfram) mines. Most of the world's rubies as well as other precious stones like jade, emeralds, sapphires, and amber are mined in Burma.

Though closely connected with India, the people of Burma belong to a different stock. They are the descendants of people who came to the country from central Asia through Tibet, and they are therefore related to the Chinese, Japanese, Koreans, Tibetans, Siamese, and Malays. The language they speak resembles the mother tongues of the Far Eastern countries.

Most Burmese are Buddhists, and they have preserved the teaching of Buddha, who came from India, in its purest form. Throughout the length and breadth of the country can be found innumerable pagodas, the traditional Buddhist shrines, on hill-tops, in valleys, and on river-banks. The oldest of these temples are covered with gold leaf and are topped with jewelled ornaments. The largest pagoda, the Shwedagon, is in Rangoon. Its golden spire rises 326 feet above the ground, which is just 37 feet lower than the cross on the dome of St. Paul's Cathedral. It has a history which goes back 2,500 years, and it enshrines sacred relics of Buddha, including locks of his hair.

The people of Burma are as colourful as the land itself. Cheerful and witty, they are

Extent : North to south, about 1,600 miles. East to west, 870 miles. Area, 261,789 square miles. Population, nearly 18 millions.
Chief Rivers : Irawadi, Sittang, Salween.
Largest Cities : Rangoon (capital, population 737,079); Mandalay (182,367); Moulmein (101,720).
Chief Products : Rice, timber, oil, minerals, precious stones.

noted for their friendliness and hospitality. They are short in stature, with round, chubby faces. The women dress in vivid silk sarongs topped with white embroidered blouses, and wear their hair wound in tall castles on their heads. The men for the most part wear skirts of sober colours, but the light silk turbans on their heads often outdo the women's sarongs in brightness. Though diligent in their work, they are a pleasure-loving people, a trait which is displayed by the fact that every month in the Burmese calendar has its own particular festival. The biggest of these is the Burmese New Year, which is celebrated in April, when the people throw water at each other. Since this occurs in the hottest part of the year, nobody objects to such wet merry-making. This festival lasts for three days. The Festival of Lights is another important one, and marks the return of Buddha from heaven when his route was illuminated by his many followers. The women of Burma enjoy great freedom of activity and have equal rights with men in law and custom. They are very business-like and can drive a hard bargain.

Besides the Burmese proper there are several tribal races in the country. The most numerous are the Karens, of central Burma. The Shans live in the hilly north-east region, the Chins and Kachins live in the north, and the Arakanese along the coastal strip adjoining India.

During the Second World War, Japanese forces invaded Burma and occupied the country in 1942. They were driven out in 1945, and Rangoon was liberated on May 3 of that year. The advancement of Burma as an independent country has been slow because of internal strife caused by rebellions by the Karens, the Communists, and other dissatisfied sections of the community. A pocket of Chinese Nationalist troops was also left behind at the end of the war, and these foreign soldiers made a nuisance of themselves by raiding lonely villages for food supplies. But discontents have been gradually removed, and stability and racial unity have returned. The country is governed by a democratic parliament consisting, like the British parliament, of two chambers.

Burns, Robert (1759–96). As a youth, the future national poet of Scotland might have been seen daily following the plough on his father's small farm, or reaping the grain in harvest time, or doing a man's full share in the other duties of the farm. One thing, however, distinguished him from the other Scottish lads whose youthful days were spent in the same hard toil. He always had in his pocket a book of verses, or an old play, or some other volume from his father's slender library; and when the horses rested at the end of a furrow he would snatch a few hasty glances at the words he loved so well, to turn them over and over in his mind while he plodded down the next furrow.

Burns was born at Alloway, an Ayrshire village, in such a home as he pictures for us in " The Cotter's Saturday Night." His father was a fine type of Scottish farmer, honest, intelligent, and God-fearing. He was anxious to give his sons the best education his means allowed, and induced some of his neighbours to join him in engaging a young teacher from Ayr, named Murdoch, for whom they hired a room in Alloway. Burns continued at school for two years after the family's removal, in 1766, to the farm of Mount Oliphant, two miles away. In 1772 he attended Dalrymple parish school to improve his writing, and in 1773 spent a few weeks with Murdoch at Ayr to revise his English grammar and study French. He had more schooling in 1777, when he went to Kirkoswald to study land-surveying. He also attended a country-dancing class " to give his manners a finish," and began to lead as gay a social life as he could. Nevertheless, between spells of education he worked hard on the farm, and at 15 he had become his father's chief labourer.

Such was the boyhood of Scotland's greatest poet, whose songs of humble life sang themselves into the hearts of the world. It was simple, but not dull. Robert heard witch tales and ghost tales in plenty, as well as his mother's singing of old ballads and his father's Bible-reading. Out of this life around him and the fire within him he made his verses:

> Gie me ae spark o' nature's fire,
> That's a' the learning I desire ;
> Then tho' I drudge thro' dub an' mire
> At pleugh or cart,
> My Muse, tho' hamely in attire,
> May touch the heart.

GETTING A LIGHT FOR A LONG SMOKE IN BURMA

R. Saidman, courtesy of "Illustrated"

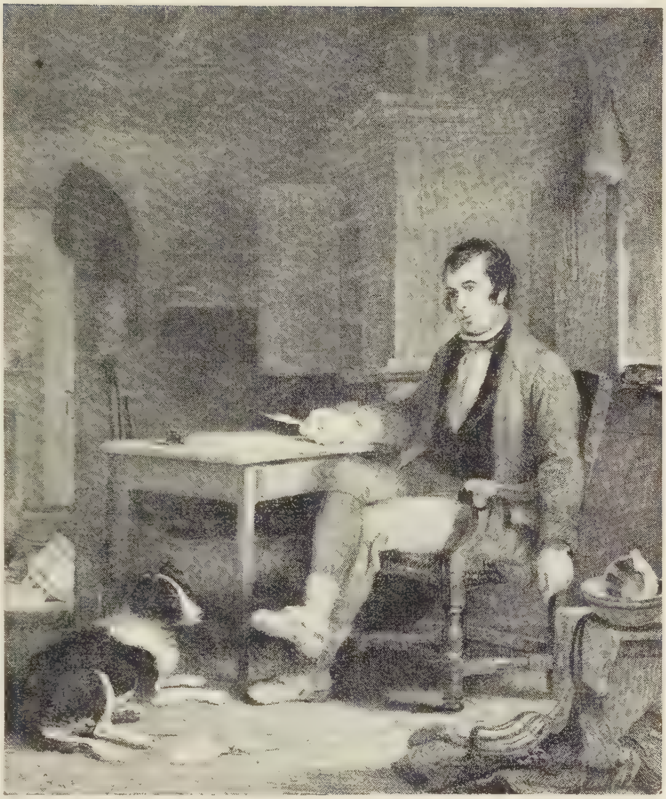
At their ease in an ox-cart, a Burmese man and woman have settled down to enjoy their home-made cigars. The Burmese are heavy smokers, and even very young children smoke - not cigarettes but cigars, like their parents. Burmese women enjoy a greater degree of freedom than do the women of most Eastern countries, and they are much more energetic than their menfolk. Most of the shopkeepers are women, and they enjoy haggling over prices.

PEOPLES OF THE BURMESE REPUBLIC

Other peoples live in Burma besides the Burmese themselves. Most of the musicians (top picture) are Burmese, stocky, brown-skinned, and Mongoloid in features. The Karen girl (bottom left) wears bamboo rings on her legs. The Karens, who live mostly in central Burma, are lighter-skinned and more almond-eyed than the Burmese. The man on the right is a Padaung, member of a tribe whose women sometimes wear as many as 20 brass rings round their necks, like a very high collar. This tends to elongate the neck.

But "the unceasing toil of a galley-slave" overtaxed the youthful poet's strength and threw him into fits of melancholy, from which in later youth he sought refuge in the tavern life of the village, forgetting his sorrows in scenes of what he called "swaggering riot and roaring dissipation."

On the death of his father, when Burns was 25, he and his brothers and sisters took another farm at Mauchline. He was beginning to find friends among the educated men of the district, and it is hardly surprising that with his poetry, and the social outlets his nature required, he was not a successful farmer. Two years later, discouraged by his struggles against poverty and by an unfortunate love affair, he decided to emigrate to Jamaica. To get money for this venture, he published a volume of the verses he had been writing for some years past. They met with instant success, and soon the fame of the Ayrshire ploughman grew so great that Burns gave up his plan to emigrate. He received £20 for the first edition (copies of which, originally costing 3s., are to-day worth a small fortune). To arrange for the second edition, which earned him nearly £500, he went to Edinburgh and was a tremendous success in the fashionable capital. Both J. G. Lockhart and Sir Walter Scott bear witness to his natural dignity and modest bearing in the company of the great scholars he met in the clubs and at the university there.



From the painting by William Allan

BURNS COMPOSING A MASTERPIECE

The first book of poems by Robert Burns was published in 1786, when the future national poet of Scotland was aged 27. The collection included the now famous "Cotter's Saturday Night," on which Burns is here pictured at work in his humble Ayrshire cottage.

In 1788 he married "Bonnie Jean" Armour, whom he had long loved, and soon after he received an excise appointment at Dumfries (this involved the collection of duties levied on spirits, beer, etc.), which, together with his farming, promised to secure him a livelihood. But the new office proved his undoing, for he was thrown more than ever into riotous company. Weakened by drink and dissipation, he contracted a fever and died at the age of 37.

Burns's excesses are the overflow of a great human spirit, generous, humorous, in sympathy with all struggling creatures and at odds with all canting, self-righteous ones.

> An honest man may like a glass,
> An honest man may like a lass,
> But mean revenge, an' malice fause,
> He'll still disdain.

He took the old Scots airs that he had loved all his life, and gave them new lyrics that have never lost the fame they quickly won—"Scots, wha hae wi' Wallace bled," "O, my luve's like a red, red rose," "Duncan Gray came here to woo," "Ye banks and braes o' bonnie Doon," "Auld lang syne," and many more. He saw nature with a working countryman's eye. The mouse,

> "Wee, sleekit, cow'rin, tim'rous beastie,"

and the mountain daisy,

> "Wee modest crimson-tipped flow'r,"

upturned by his plough are immortalised, and nobody has bettered his often-recurring descriptions of wild weather. But above all he observed and enjoyed his fellow men, and it is in his rollicking satirical and humourous verse—in his "epistles" to his friends, in his drinking poems, above all in "The Jolly Beggars" and in the narrative of Tam O'Shanter's brave brush with the Devil—that perhaps the best of Burns is to be found by the discerning.

Scotsmen throughout the world still celebrate Burns's birthday on January 25.

Burton, Sir Richard Francis (1821–90). As the discoverer of Lake Tanganyika in 1858, Sir Richard Burton would have claim enough to fame. But this expedition to unmapped Central Africa (which he undertook, with J. H. Speke, in the hope of finding the sources of the Nile) was no more than an incident in his crowded career.

Burton was much more than an African traveller; he was a world explorer of the most tireless character. His journeyings ranged from Iceland to India, from Arabia to the Argentine Republic, from East Africa to the western states of North America. He crossed the Andes, returning through the Straits of Magellan, canoed down the São Francisco river in Brazil and voyaged many hundreds of miles up La Plata and the Amazon. In 1854 he was the first white man to visit Harar,

WOODS AND ROCKY HEADLANDS OF THE KYLES OF BUTE

The narrow winding channel separating the island of Bute from the mainland of Argyllshire, Scotland, is known as the Kyles of Bute. It is noted for its scenery, and is about 16 miles long but seldom more than a mile wide. Bute is the most important of the islands comprising the county of Buteshire, and Rothesay, the chief town and a popular seaside resort, is known as the Brighton of the Clyde. When the Scots came over from Ireland, they settled first on Bute.

now in Ethiopia, but then capital of Somaliland. One of his most daring exploits was his journey in 1853 to Mecca, the Mahomedan holy city in Arabia, disguised as an Afghan pilgrim.

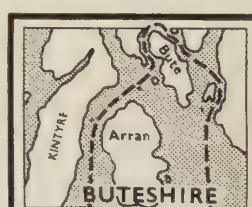
After a childhood spent travelling in Europe, Burton went to Oxford, but contrived to get " sent down " so that he could be a soldier instead of a parson, as his father wished. At 21 he became an officer in the Indian army (under the East India Company) and served until 1861, when he joined the consular service. He was appointed in turn to Santos (Brazil), Damascus, and Trieste, where he died and is buried.

BURTON IN DISGUISE

The greatest traveller of his day, Sir Richard Burton (seen in this early photograph in Oriental costume) explored regions of Africa and Asia not before visited by white men.

Burton was a great linguist, and was particularly fascinated by Arabic and the Arab way of life. He wrote many books on his travels, but his great literary monument is his translation of *The Arabian Nights*. A skilled swordsman, horseman, and shot, imbued with an intense love of adventure and exploration, Burton has been well called " an Elizabethan out of his time."

Buteshire. One of the smallest of the Scottish counties, Buteshire consists of seven islands in the Firth of Clyde : Bute itself, on which is Rothesay (population in 1951, 10,145), the county town ; Arran, not to be confused with the Aran group off the Irish coast ; Great and Little Cumbrae ; Holy Island ; Pladda ; and Inchmarnock. On the island of Bute ripe strawberries and roses are often found in December, because of the moist, mild climate. The beautiful Kyles of Bute separate the group from the mainland, which is part of Argyllshire. Goat Fell (2,866 feet) is the highest of the group of mountains on Arran. Holy Island shelters Lamlash Bay, a natural harbour on the east coast of Arran, much used by Transatlantic convoys in the First



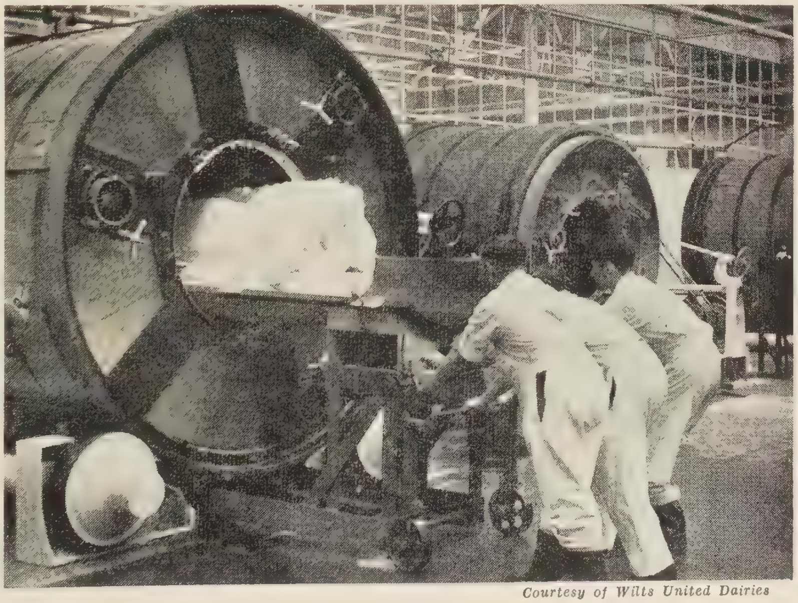
World War, while Loch Ranza on the north coast is both a well-known beauty spot and a herring fishing centre. The area of the county is 218 square miles; the population in 1951 was 19,285, of whom two per cent. spoke Gaelic.

Butter. In the English-speaking countries and in most of Europe and South America, all but a very small amount of the butter is made from cow's milk, but in many countries of the East the milk of sheep, goats, and domesticated buffaloes is used. In certain Eastern countries butter is still made by the ancient method of shaking a skin or gourd full of milk until the particles of butter fat are separated from the rest of the liquid. An even more primitive method is to attach the skin of milk to the back of a moving horse or other animal, so that it is jolted up and down. Perhaps butter was first discovered by accident centuries ago, by some rider who, after a long journey, opened his skin of milk to find small pieces of butter, "churned" by the motion of the horse, floating on top.

Most of the butter eaten in the United Kingdom is imported, chiefly from New Zealand, Australia, Denmark, the Netherlands, and Ireland. Before the Second World War, when butter was plentiful, the United Kingdom was consuming on the average just over half a million tons a year, of which only about 22,000 tons were made there (not including butter made by farmers for their own use).

While small amounts are still churned by hand in many farmhouses, all the butter sold in Great Britain is made in factories (called creameries), some of which can produce up to 100 tons a day. Vast quantities of milk are required, for between $2\frac{1}{4}$ and $2\frac{1}{2}$ gallons are needed to make 1 lb. of butter. Milk contains a very high proportion of water, and the butter-maker must get rid of most of it. To do so, the cream, which contains the butter fat, is separated from the skim, the watery part of the milk. There is still, however, quite a lot of water in the cream.

After pasteurisation (*see* MILK) to make sure that it contains nothing harmful to health, the cream is chilled overnight and on the following day put into huge churns which on the average will each make up to a ton of butter at one churning. The churns are turned mechanically for between 20 and 30 minutes until the butter is in the form of small grains, about the size of lead shot. The remaining liquid, the buttermilk, is then drained away. After the grains in the churn have been washed, and a small amount of salt has been added—in order to give flavour to the butter as well as to make it keep better—the churn is turned again until the motion produces the solid butter.



Courtesy of Wilts United Dairies

REMOVING BUTTER FROM A GIANT CHURN

To make butter in very large quantities huge churns are needed. Those seen here are mechanically operated and produce three tons of butter at a time. The butter, which is already salted, is removed automatically. About one pound of butter is made from $2\frac{1}{2}$ gallons of milk, of which the fat content is 3·6 per cent.

Butter has not always been used as it is used to-day. The ancient Romans were massaged with butter after bathing; and it has been used as a medicine and as an oil for burning in lamps. In India, Pakistan, and central Asia a clarified butter called ghee is made by boiling freshly-made butter and adding salt and sometimes sour milk and herbs. In Tibet lumps of ghee made from yak's milk are often stirred into tea.

Buttercup. The poet Browning speaks of "buttercups, the little children's dower." Crowfoot is another name for this flower, particularly for those kinds found in water or damp places. In the great family *Ranunculaceae*, containing plants as different as anemones and delphiniums, the *Ranunculus* genus (group) includes all the buttercups. Each kind contains a bitter juice and this makes them distasteful to grazing animals. Most of them have deeply divided leaves, and their flowers have five sepals and usually five bright yellow petals. The brilliant colour is due to each petal's being glossy on most of its upper surface. At the duller point where the petal joins the flower is a tiny, heart-shaped pocket containing nectar. A crown of yellow stamens hides a globular cluster of separate green carpels, which are the pistil. In older flowers the stamens droop and the pistil is easily seen.

The three commonest British buttercups can be distinguished as follows. The bulbous buttercup, *Ranunculus bulbosus*, has a corm (see article) under the ground, not a bulb. Its flower stalks are grooved and the sepals bend down to the stalk. The meadow buttercup, *Ranunculus acris*, is tallest of the three (2 to 3 feet on rich soil). Its stalks are smooth and the sepals remain touching the petals.

H. Bastin

BUTTERCUP OF GOLDEN HUE

Meadows and pastures of Britain are gay with the gold of this buttercup (*Ranunculus acris*) in June and July. The stems vary from one to three feet in height. When the flowers are fully expanded, the petals are almost flat, and at the base of each petal is a pocket containing nectar.

The creeping buttercup, *Ranunculus repens,* grows about a foot high in waste places and as a weed. It has creeping stems, dark green leaves, ridged flower stalks, and sepals which do not bend down. Goldilocks is a woodland buttercup often with deformed petals. Two smaller and annual kinds (*i.e.* living only one year) are the hairy buttercup and corn buttercup, both found in dry fields. On the wet banks of streams and ponds grow greater and lesser spearwort, two buttercups with much simpler leaves, and the hollow-stalked celery-leaved buttercup with small flowers and club-shaped pistils. The little water buttercup or water crowfoot grows in ponds and ditches. Its flowers make a starry, white spread on the water in spring and summer, and have no nectar pockets on the petals. The leaves are shaped like very blunt ivy leaves and there are usually special underwater leaves looking like little tufts of delicate green threads, quite unlike ordinary leaves. All buttercups, and more especially the celery-leaved variety, are harmful to cattle.

MOST BEAUTIFUL *of all the* INSECTS

Butterflies AND MOTHS. "Stemless floating flowers" is a poet's fanciful description of butterflies. Scientists know them as a large group of insects which, with the moths, make up the order *Lepidoptera*, meaning "scale wings." They are so named because the wings of both butterflies and moths, as well as certain portions of their bodies, are covered with a very fine, soft, glistening dust, which, if examined under a microscope, is seen to be made up of millions of little scales, very variable in size and shape. Some of these scales are like little feathers, some resemble fans; and each has a tiny stem by which it is fastened.

Method of Identification

Most of the butterflies fly during the daytime and sleep during the night; with the moths it is often the reverse. A good way to distinguish between moths and butterflies is by the shape of the antennae, or feelers. The antennae of butterflies are thin, and have their ends rounded into little clubs or knobs, while the antennae of most moths are not tipped by knobs. The antennae of many moths are shaped like minute feathers. Also, butterflies usually hold their wings vertically over their backs when at rest, while moths let them lie open. Abroad, many moths are day-flying, and sometimes resemble butterflies in appearance.

It is a mistake to think that the moths are all plain and sombre in colour, while butterflies are brilliant. Some of the most beautifully coloured members of the order *Lepidoptera* are moths.

A butterfly has a long, slender body, two long, thread-like antennae or feelers on the front of the head, and six slender and fragile-looking legs. From its thorax, the middle section of the body, grow two pairs of broad wings, covered with the dust-like scales. It is these scales that give the wings their colour. The front pair of wings is, as a general rule, larger than the hind pair.

The "feeding apparatus" of a butterfly or moth consists of a long, slender tube, the proboscis, which, when not in use, is kept coiled up like a delicate watch-spring. With this long tube the insect probes deep into the nectaries of flowers, where the liquid is stored, and drinks up this substance for its food.

The stages in the life-cycles of the butterfly and the moth are identical. The female lays many eggs, and from these hatch out caterpillars or larvae (*see* CATERPILLAR). These crawl among the leaves of plants and feed on them. Or they consume other food, as explained later. In fact, caterpillars have nothing to do but eat. Food is stored up in the body in the form of fat, and is used to build up wings, legs, sucking tubes, etc., when the caterpillar turns into a chrysalis.

When the caterpillar is full-grown, it spins a button of silk, to which it clings; it sheds its caterpillar skin, and then appears in compact form as a legless and wingless pupa or chrysalis. The caterpillars of many moths make themselves cases or chambers called cocoons for the chrysalis stage, some of leaves or silk, others covered with the hair

[*Continued on page* 149

LIFE CYCLE OF A SWALLOWTAIL BUTTERFLY

Specially drawn for this work by E. C. Mansell

1. The egg. 2. The caterpillar, or larva, when hatched. 3. After the first change of skin, showing the V-shaped organ which develops : this is visible only when the caterpillar is irritated. 4. Larva ready to pupate. 5. The larva fastens itself to a stem by a single thread. 6. Chrysalis beginning to emerge from the old skin. 7. The chrysalis, or pupa. 8. The butterfly breaks the skin of the chrysalis. 9. Butterfly clear of the chrysalis. 10. Wings begin to expand. When the wings have dried, the insect is ready for flight. 11. The complete butterfly.

PICTURES OF SOME BRITISH BUTTERFLIES

1. Small Meadow Brown, or Gatekeeper. 2. Clifden, or Adonis Blue 3. Clouded Yellow, male. 4. Clouded Yellow, female. 5. Underside of the Swallowtail. 6. Swallowtail. 7. Underside of the Silver-washed Fritillary. 8. Silver-washed Fritillary. 9. Red Admiral. 10. Underside of the Red Admiral. 11 Small Tortoiseshell (Large Tortoiseshell on page 144). 12. White Admiral.

MORE MEMBERS OF THE BRITISH BUTTERFLY FAMILY

13. Marbled White. 14. Comma. 15. Small Copper. 16. High Brown Fritillary. 17. Dingy Skipper. 18. Bath White. 19. Green-veined White. 20. Large White. 21. Meadow Brown. 22. Green Hairstreak. 23. Purple Emperor. 24. Black-veined White. 25. Wood White. 26. Small White. 27. Ringlet. 28. Bedford Blue. 29. Peacock. There are more pictures over the page.

OTHER BUTTERFLIES SEEN IN THE BRITISH ISLES

30. Grizzled Skipper. 31. Dark Green Fritillary. 32. Common Blue. 33. Purple Hairstreak. 34. Grayling. 35. Brimstone. 36. Large Tortoiseshell. 37. Silver-studded Blue. 38. Speckled Wood. 39. Orange Tip. 40. Pale Clouded Yellow. 41. Large Blue. 42. Camberwell Beauty, a rare visitor from Scandinavia. 43. Painted Lady. 44. Wall. 45. Queen of Spain Fritillary.

SOME UNCOMMON AND SOME EXTINCT BUTTERFLIES

46. Glanville Fritillary. 47. Lulworth Skipper. 48. Brown Argus. 49. Large Heath. 50. White Letter Hairstreak. 51. Small Ringlet. 52. Mazarine Blue, underside. 53. Mazarine Blue (extinct). 54. Brown Hairstreak. 55. Small Heath. 56. Chalk Hill Blue. 57. Scotch Brown Argus, underside. 58. Scotch Brown Argus. 59. Marsh Fritillary. 60. Small Skipper. 61. Burgundy Fritillary, underside. 62. Burgundy Fritillary. 63. Chequered Skipper, underside. 64. Chequered Skipper. 65. Scotch Argus. 66. Heath Fritillary. 67. Large Skipper. 68. Large Copper (extinct). 69. Pearl-bordered Fritillary. 70. Small Pearl-bordered Fritillary. 71. Holly Blue. 72. Black Hairstreak. 73. Silver-spotted Skipper. Other Fritillaries on pp. 142 and 144.

FINE MOTHS FROM MANY PARTS OF THE WORLD

1. *Acherontia atropos* (Death's Head), Britain. 2. *Amesia sanguiflua*, N. India. 3. *Erasmia pulchella*, India, China. 4. *Ophideres fullonica*, Africa, Asia, America, Australia. 5. *Miniodes discolor*, W. Africa. 6. *Chrysiridia madagascariensis*, Madagascar. 7. *Pericallia galactini*, China, India, Borneo. 8. *Egybolis vaillantana*, Africa. 9. *Attacus atlas* (Atlas Moth), India, China, Ceylon. 10. *Daphnis nerii* (Oleander Hawk Moth), Britain, Asia, Africa. 11. *Zygaena filipendulae* (the Six-spotted Burnet), Great Britain. 12. *Gloriana ornata*, N. India.

MOTHS OF TROPICAL AND TEMPERATE REGIONS

13. *Euchloron megaera*, Africa. 14. *Polythysana rubescens*, Chile. 15. *Smerinthus ocellatus* (Eyed Hawk Moth), Britain. 16. *Diacrisia purpurata*, Europe, Japan. 17. *Eustera brachyura*, Sierra Leone. 18. *Callimorpha dominula*, Britain. 19. *Nudauretta zaddachii*, S. Africa. 20. *Gynanisa maia*, S. Africa. 21. *Arctia caja* (Tiger Moth), Britain, Asia, America. 22. *Milionia zonea*, N. India. 23. *Euschemia militaris*, India, China. 24. *Deilephila euphorbiae* (Spurge Hawk Moth), Britain, Asia. 25. *Histia flabellicornis*, India. 26. *Xanthospilopteryx superba*, Africa. 27. *Brahmaea wallichii*, N. India. 28. *Sphinx ligustri* (Privet Hawk Moth), native to Britain.

BRITISH MOTHS MAY BE BRIGHT OR DRAB

29. Yellow Underwing. 30. Small Yellow Wave. 31. Cinnabar Moth. 32. Red Underwing. 33. Emperor Moth (female). 34. Large Emerald. 35. Poplar Hawk. 36. Clouded Border. 37. Cream-bordered Green Pea. 38. Oak Eggar (male). 39. Humming Bird Hawk. 40. Magpie. 41. Swallowtail Moth. 42. Brimstone Moth. 43. Cream Spot Tiger. 44. Kentish Glory (female).

In the magnified butterfly's head left can be seen the big eyes beneath the long, jointed antennae, the proboscis, and the feelers which guide the insect. When at rest the proboscis, a sucking tube through which the insect takes up its food, is curled neatly between the feelers. For comparison, the antennae of a moth are shown on the right.

BUTTERFLY AND MOTH UNDER THE MICROSCOPE

A moth's tongue under the microscope (left) is seen to have an uneven surface. The dark spots and little projections are probably taste organs. The antennae of butterflies are clubbed or swollen at the tips (upper right) ; below is the antenna of a tussock moth, with the stem jointed and edged with a fringe. Butterflies and moths have the wings more or less thickly covered with minute scales brightly coloured on the upper surface. The under side is usually protectively patterned so that the butterfly at rest resembles its surroundings.

from the caterpillar's own body, while some species construct chambers of wood or earth.

For some time (weeks or months) the pupa or chrysalis remains apparently asleep, but during this time it gradually changes inwardly, until presently there emerges from the pupa-case a butterfly or moth. When it first emerges from the chrysalis it sits still for a time, in order to let its thin, moist, crumpled wings spread out. Then it waves them slowly to dry them. When they have expanded and dried, it is ready to fly away in search of nectar-producing flowers and of its mate.

Many of the butterflies and moths which live in tropical countries are brilliant in colour and very large. Some measure 14 inches from tip to tip of the wings, while the British great convolvulus hawk moth exceeds five inches.

Butterfly Camouflage

Some butterflies are shaped and coloured so as to resemble parts of the plants on which they rest, especially when the wings are held so that the undersides alone are exposed. The dead-leaf butterfly of India, when perching on a twig with its wings closed, looks almost exactly like a dead leaf. This is to hide the creature from its bird enemies. Among British species, many moths resemble the bark of trees in the same way, while the comma and brimstone butterflies can be quite easily mistaken for leaves.

Among the best-known moth caterpillars are the silkworms, whose cocoons supply the natural silk of commerce. The caterpillars of some of the smaller moths are very destructive to furs, and also to woollen cloths and other fabrics. Many larvae are destructive to crops and trees, annually causing great loss. The gipsy moth, for instance, is by no means a selective feeder, for it eats no fewer than 500 different species of plants, and causes immense damage as a forest pest.

Some caterpillars live in the interiors of apples ; like, for example, that of the codling moth. The moth itself is quite small but decidedly pretty and, common as it is, one does not often see it because it so closely resembles the rough tree-bark on which it may be resting. Its caterpillars belong to that

destructive list of insects against which growers of food—in this case, apples—are continually at war. The parent codling moth lays an egg in the centre of an apple flower, and when the caterpillar (or grub) hatches out it proceeds to eat the core of the growing apple, and eventually gnaws its way out through the side and makes its way down to the ground, where it buries itself and becomes a chrysalis. Or the apple may fall and so save the caterpillar its climb down. Many apple "windfalls" are due to this small and hungry tenant—and through taking an incautious bite at a windfall, before the caterpillar has had time to leave it, you may have made this small pest's sudden acquaintance!

The goat moth caterpillar lives out of sight like the codling moth, but in the wood of a growing tree where, with one notable exception, birds and other natural enemies cannot get at it. The notable exception is the industrious woodpecker. The goat moth caterpillar is a great spoiler of timber, and though it is not visible its presence is made very plain by the goat-like odour it exudes. In three years this caterpillar continues to gnaw a passage through the wood. Eventually, fat and smooth and usually (but not always) mahogany coloured, and up to four inches long, it leaves its burrow in the tree and enters the soil at the base of the trunk. There it constructs a cocoon of wood-chips or other debris, becomes a chrysalis, and in due course emerges to the light of day as a moth with a wingspan of about three inches.

Some caterpillars carry with them their own means of protection against birds. For example, the bustling woolly bear (larva of the tiger moth) has a coat of long hairs at which the hungriest bird would look with disfavour. But few caterpillars are proof against the attentions of another deadly enemy, the ichneumon fly (see article).

Normally very few butterflies or moths are seen about in winter unless the warmth of a room in which the insect had intended to sleep the winter through, in some dark corner or crevice, encourages it to make an unseasonable appearance. Of the few hardy *Lepidoptera* which do naturally venture out-and-about then, the commonest British kind is named the winter moth. It is small but quite attractive in appearance, and its caterpillars are very destructive to the buds of fruit-trees.

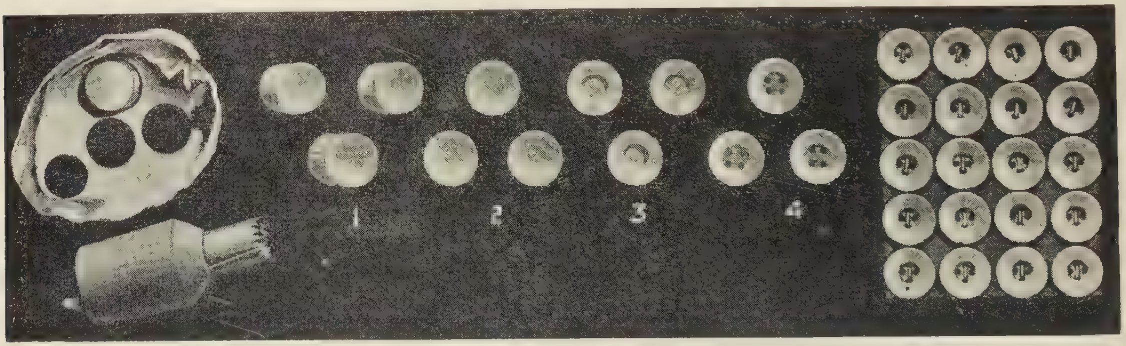
This winter moth is also noteworthy for the fact that the female has no wings and therefore, to lay her eggs in the tree buds, she has to crawl up the trunk. Fruit growers wrap narrow bands of greased paper around the trunks so that the moths are caught in their upward climb.

How high above sea level can members of the butterfly and moth family live? The question has never been answered with scientific exactness. Butterflies have been found on the heights of the Andes, as well as in the towering Himalayas and the Swiss Alps.

Buttons. Even in an age of "Zip" fasteners it is hard to imagine life without buttons; yet for many centuries people managed to dress elaborately enough without them. Buttons from the ancient world have survived, but although designs on Greek vases occasionally show women whose dress appears to be fastened very practically with buttons along arms and shoulders, most ancient specimens seem to have been more for ornament than for use. Amethyst and cornelian buttons have been preserved in Egyptian tombs, and elsewhere buttons have been found adorned with cameos and painted miniatures, as well as jewels and precious metals. In China under the Manchu emperors the Mandarins wore different ornamental buttons on their hats to show their rank. The most important were called Mandarins of the First Button, and so on.

In Europe from about the 11th century onwards, buttons seem to have been used now and then for adornment, but it was not until the 15th century that they began to be used to any extent as fastenings, and even then there were waves of fashion when laced and tied fastenings completely ousted buttons. Not until the 18th century did use finally supersede adornment—and one curious ornamental use still survives in the "pearly" costumes of London costermongers.

Metals and glass, cattle-hoofs and sea-shells, milk and tropical nuts—buttons may be made from all these and many more substances. All buttons must either be pierced with holes for sewing through, or have a shank, either of metal or of canvas or similar material, so that they can be sewn from the back without the stitches showing at the surface. The shank type is often covered with the material of the garment on which it



BUTTONS MADE FROM SEA SHELLS

Pearl buttons are not made from pearl, of course, but from different kinds of sea shell. In the first process of their manufacture, blanks are cut out of the shell (extreme left) by a tubular drill (left below). Three blanks are shown: (1) just as they are cut out, and (2) after being ground down. At (3) a little pit has been sunk in the centre, and at (4) the holes have been drilled. The buttons are sewn on cards (right) after being polished, and are then ready for sale.

is to be worn. Nearly all buttons are now made by machinery, and there are two methods of manufacture—machining and moulding. Machined buttons are cut or stamped out of hard material—bone, horn (made by boiling the hoofs of cattle), wood, pearl (made from pearl-oyster and other shells), metals, casein (made from milk), vegetable ivory (made from the South American corozo nut, or doom-palm nuts from Eritrea and the Sudan). Moulded buttons are made from glass and plastic moulding powders.

Birmingham was the first home of button manufacture in England, and remains an important centre. Metal buttons were its speciality. Some steel buttons with facets made about 1767 sold for 140 guineas a gross—roughly £1 apiece. Hand-fashioning of buttons like these was the work of skilled and highly-paid craftsmen. Many new and improved methods of manufacture originated in Birmingham in the 18th and 19th centuries. For instance, a Dane named Sanders who settled there after he had been ruined in the 1807 bombardment of Copenhagen introduced methods of making covered buttons, and elaborate modern automatic machines still use basically similar processes. Porcelain buttons were also a Birmingham invention, though their manufacture was developed in Czechoslovakia, which also became the centre for glass buttons.

Moulded buttons are a United States speciality, while France concentrates on decorative metal and covered buttons, and Italy on vegetable ivory, which dyes very well, as also does casein. London is the centre of the world's trade in mother-of-pearl shells for buttons. These come chiefly from Australia, though the United States has its own trade in a fresh-water shell. Incidentally, the first small pearl buttons known to be used for underwear are on a shirt worn by King George IV in 1827 and now in the Castle Museum at York.

BUZZARD GUARDING HER NEST

When it nests in a tree, the buzzard builds a large and rather untidy structure of sticks and heather. The eggs are whitish, with brown, red, and purplish markings. A heavy bird, and often a lazy one, the buzzard has a slow flight, but once high in the air it gives a wonderful exhibition of soaring, scarcely seeming to move its wings.

Buzzard. If you are in the West Country, the Lake District, the Highlands of Scotland, or in Wales, you may one day see, high up in the sky, a big brown bird that you assume to be an eagle. But eagles are confined to a very few places in Britain now, and the bird is, almost for certain, a buzzard, which comes zoologically between the eagle and the hawk.

The buzzard's most characteristic feature is its magnificent, soaring flight. To see a pair of these large birds sweeping round and round, often at a great height, with no perceptible movement of the wings, is an unforgettable experience for the bird-watcher. The call is a plaintive "wheeioo." The birds feed mostly on the smaller mammals, carrion, dead lambs, small birds, and even worms. Buzzards build their large nests in trees or on cliff ledges. The eggs, which are whitish with red-brown blotches, should be looked for early in May.

Besides the common buzzard (*Buteo buteo buteo*), other buzzards occur in England, such as the rough-legged buzzard (*B. lagopus lagopus*), a fairly regular winter visitor, and the very rare honey buzzard (*Pernis apivorus apivorus*).

In N. and S. America there is a bird called the turkey buzzard (*Cathartes aura*), which is not a true bird of prey but a scavenger, being in fact a member of the vulture group. Although a fine sight on the wing—its span being often six feet—it is a most repulsive bird when seen at close quarters, the head and upper neck being without feathers.

Byrd, Richard Evelyn (1888–1957). Seven hundred miles from the South Pole, and 123 miles from the nearest of his companions, a man lay in his sleeping-bag in a hut buried in the snow. Half-frozen, ill from the fumes of the oil lamp that was all the light he had in the Antarctic winter, for six weeks he had lacked the strength to prepare food, living on the contents of tins stored beneath his bed. Yet he never failed to read the scientific instruments with which his hut was filled and to record the figures in his log. He kept in touch with Little America, his base on the Ross Ice Barrier, by wireless; and when his signals grew feeble and irregular, an expedition was sent to relieve him. His solitary vigil had lasted four and a half months.

This dauntless explorer was Captain Richard Byrd, of the U.S. Navy. His was a life filled with adventure. Born in Winchester, Virginia, on October 25, 1888, he set out at the age of 12 on a journey round the world alone. After training at the University of Virginia and the U.S. Naval Academy he became a naval officer, and in 1925 he took part in his first polar expedition as flight commander of the naval unit of the MacMillan expedition to Greenland. Piloted by Floyd Bennett, he made the first aeroplane flight over the North Pole (May 9, 1926), taking off from King's Bay, Spitsbergen, and returning 15 hours later. In 1927 Byrd and three friends flew the Atlantic in the monoplane *America*. The flight of 4,200 miles, accomplished in 43 hours, ended in a forced landing in the sea off France.

ADMIRAL BYRD

The United States explorer Admiral Byrd was the first man, with Floyd Bennett, to fly over the North Pole, and later first over the South Pole. Here he is seen dressed in his Arctic kit.

Byrd's first Antarctic expedition set out in 1929. With two ships and the most modern equipment, he landed on the Ross Ice Barrier at the Bay of Whales, and set up the permanent base called Little America. He discovered the land which he named Marie Byrd Land, after his wife, and made the first flight over the South Pole (Nov. 29, 1929). His achievements earned him promotion to rear-admiral in 1930.

In 1933 he headed a second expedition, and it was in 1934, from March 28 to August 11, that he carried out the meteorological observations in the lonely hut that so nearly cost him his life, as described above. The U.S. government sent him again to the Antarctic in 1939–40.

After serving in the Pacific with the U.S. Navy during the Second World War, Admiral Byrd returned once more to the Antarctic in 1946 with the largest and most extensively equipped expedition in the history of Polar exploration. He took with him ships, aeroplanes, tracked vehicles which could traverse the rough snow-covered ice at more than 50 miles a day, and 4,000 men. In 1955 he was given charge of U.S. activities in the Antarctic, with a view to establishing a permanent base. Among his books are *Discovery* (1935) and *Alone* (1938). (*See* POLAR EXPLORATION.)

Byron, GEORGE GORDON NOEL, 6TH BARON (1788–1824). Though Lord Byron's reputation as a poet does not stand as high as it did in the mid-19th century, he still has an honoured place in the story of English literature. He brought into English poetry a freshness of subject and treatment, a force, a rapidity and colour which had been lacking all through the 18th century. And his wild, eventful, adventurous life, coupled with his unusual personal beauty, made him one of the best-known of all Englishmen, not only in his own country but throughout the whole of Europe.

Byron was, in fact, half Scots. His father, a Guards officer known as "Mad Jack" Byron, married a Scottish lady, Catherine Gordon of Gight. The boy was partly lame from early childhood, and his sensitiveness about this disability caused him acute distress. It also debarred him from active running games, but he became a magnificent swimmer.

He succeeded unexpectedly to the peerage in 1798. Educated at Harrow and Trinity College, Cambridge, he began early to write poetry. His juvenile volume, *Hours of Idleness* (1807) was savagely attacked in the *Edinburgh Review*, and Byron produced an equally savage reply in "English Bards and Scotch Reviewers" (1809), written in the style of Alexander Pope (of whom he was a great admirer). This was nicely wrought, but too obviously an outburst of temper; and Byron withdrew it in 1811. In 1809 also he made his "grand tour," visiting Portugal, Spain, Malta, Athens, Smyrna, and Constantinople. In 1812 he published the first two cantos of "Childe Harold's Pilgrimage," using a difficult nine-line stanza associated with the earlier poet, Edmund Spenser. It was something fresh in English poetry, and was so successful that, as he said himself, "I awoke one morning and found myself famous." He became a social "lion," and

Sir John Murray

LORD BYRON

Handsome, and greatly talented, Byron became one of the most famous men in Europe. He brought new colour and life into English poetry. Portrait by Thomas Phillips (1770–1845).

between 1813 and 1816 produced some of his best-known works, including "The Giaour," "The Bride of Abydos," "Lara," and "Parisina." In 1815 he married Anne Isabella Milbanke, but she left him at the end of a year, refused to see him again, and set afoot inquiries as to his sanity.

In 1816 Byron left England never to return. He lived successively on the Lake of Geneva, at Venice, at Ravenna, at Pisa, and elsewhere. One love-affair gave place to another—but there was also plentiful production of verse, including "Beppo" (1818), "Cain" (1821), and "Don Juan" (1819–24). This last, written in eight-line stanzas, a device of Italian poets, is generally reckoned to be his best contribution to literature, and the finest comic poem in English. Its wit, colour, variety, quick movement, and "bite," carried through 16 long cantos (or verse chapters), make it a very remarkable achievement, and it remains unique of its kind.

Loved by many, hated by not a few; by turns gay and melancholy, handsome, witty, warm-hearted, and eccentric, the extravagant English "milord" became famous throughout Europe. In Italy, where he mostly lived, he eventually aroused the suspicion of the police—for, proud though he was of his aristocratic birth, he was an advanced radical in politics. In 1823 he gave money in support of a rebellion by the Greeks against their Turkish masters, and in December of that year he arrived at Missolonghi, Greece, to take part in the fighting. The climate was appalling and the conditions were rough. Byron was quickly stricken by a fever, and died on April 19, 1824.

"SHE WALKS IN BEAUTY"

By Lord Byron

I

She walks in beauty, like the night
  Of cloudless climes and starry skies;
And all that's best of dark and bright
  Meet in her aspect and her eyes:
Thus mellow'd to that tender light
  Which heaven to gaudy day denies.

II

One shade the more, one ray the less,
  Had half impair'd the nameless grace
Which waves in every raven tress,
  Or softly lightens o'er her face;
Where thoughts serenely sweet express
  How pure, how dear their dwelling-place.

III

And on that cheek, and o'er that brow,
  So soft, so calm, yet eloquent,
The smiles that win, the tints that glow,
  But tell of days in goodness spent,
A mind at peace with all below,
  A heart whose love is innocent!

EUROPE'S BULWARK *against* ASIA

Byzantine Empire. In the fourth century A.D. the Roman Empire had grown too large to be successfully governed from Rome. At that time the frontiers most threatened by barbarians were those of the Danube and Syria, and the place chosen by the Emperor Constantine for a new capital was much nearer both of them; at the same time it combined, in Gibbon's words, the prospects of beauty, of safety, and of wealth.

A great port on the main east-west trade route, and a first-class fortress, Byzantium had been founded about 657 B.C. by Greeks from Argos and Megara. Plenty of misfortune darkened the early history of the city, placed as it was where warring Persians, Greeks, and Romans crossed and re-crossed the Bosporus. Roman civil wars brought capture and pillage in A.D. 196 and 263, and a final surrender to Constantine in 328. Rebuilt, re-fortified, and renamed Constantinople, in 330 the city entered upon its greatness. Rome was a stronghold of ancient religions and customs; Constantinople the "Second Rome," was consecrated with Christian ceremonies, and gladiatorial games were never permitted there.

The history of imperial Byzantium—the name continued to be used—falls roughly into five periods. The first extended to the division of the Roman empire into eastern and western halves in 395. Successors of Constantine carried on the building of the city, adding harbours and aqueducts and developing the famous fortifications. Already in 378, after the Emperor Valens was killed and his army destroyed at Adrianople, the victorious Goths (see article) advanced, saw the tremendous walls, and retreated in dismay without attacking them.

During this period Christianity was established as the state religion by the emperor Theodosius I (378–395). The gradual division of the Church into eastern and western branches began almost at once. (The main doctrinal difference was, and is, that to the Roman Catholic the Holy Spirit proceeds from both God the Father and Christ the Son, while to the Greek Orthodox believer It proceeds from the Father only.)

The second period lasted from the great division to the extinction of the Western Empire in 476. After the split the Eastern Empire consisted of most of the Balkans, Greece, the Aegean Islands, Crete, Cyprus, Asia Minor, Syria, Palestine, and Egypt. Invasions, court intrigues, and east-west rivalry abounded, but the great walls discouraged Attila the Hun in 447.

The third period, 476–565, led up to and included the climax of Byzantine power and glory, when the armies of Justinian (who became sole emperor in 527) were led by his great general Belisarius to defeat the Persians, extinguish the Vandal empire in North Africa, and reconquer Italy. Early in his reign Justinian had to suppress the savage "Nika" revolt in the capital (Nika means Victory and was the war-cry of the mob). The municipal factions of Greens and Blues—who quarrelled about everything, including religion, but most of all about chariot-racing in the hippodrome—united to rescue some condemned criminals of both their parties. Fire and destruction spread through the city; Justinian was only restrained from flight

by the courage of his beautiful wife, the former actress Theodora ; and Belisarius with barbarian troops trapped the mob in the hippodrome and is said to have slaughtered 50,000 in a few hours.

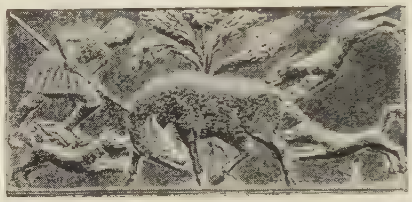
So large and vital was the population that this episode seems to have made little difference to the city as a whole. Justinian at once began to rebuild ; among the restored churches rose the greatest church of all, Sancta Sophia (Holy Wisdom), which although damaged by earthquake in 558 was again immediately restored. After nearly nine hundred years as a church, and five hundred years as a mosque, this magnificent building is now a museum—the supreme expression of the domed Byzantine architecture, and a perpetual reminder of the criminal folly and commercial greed of the medieval Europeans who let it pass out of the keeping of Christendom.

Justinian built law-courts, churches, and fortresses all over his empire ; at Ravenna, from 534 to 742 the principal Byzantine stronghold in Italy, portraits of himself and his empress still glow in the dusky splendour of mosaic, a form of art in which the Byzantines excelled. Justinian's chief fame was as a lawgiver, and his great revision of the old Roman laws became the starting-point of systematic legal study in Europe. When he died in 565 his dominions almost enclosed the Mediterranean, and, if vassal states are counted, included three-quarters of the shores of the Black Sea.

After Justinian the Byzantine story is one of withdrawal and decline ; but if its full strength be set at the triumphal entry of Justinian's army into Rome in 554, the empire was nine hundred years a-dying, and its much-advertised decadence was long exaggerated by historians. The plots and betrayals of courtiers and generals, the violent ends of short-lived dynasties, the plagues and famines and external dangers, themselves point to an underlying strength in the state that endured them.

The fourth period, 565–1204, included the loss of great provinces, the almost constant pressure of Persian, Avar, Slav, or Bulgar, and of the rising power of Islam. The emperor Leo III in 726 abolished the use of images in churches, widening the gap between west and east, for the Italians supported the popes in resisting what they called the iconoclastic (image-breaking) heresy. In 786 the Empress Irene secured a temporary peace in the Church ; the failure of Charlemagne to obtain the hand of this gifted woman in marriage contributed to his setting up in 800 of a new empire in the west. In 842 the cult of images was restored at Constantinople.

Between the ninth and eleventh centuries the city was four times attacked by Russian fleets or



BYZANTINE CRAFTSMANSHIP IN SUPERB CARVINGS

On the left is a 12th-century carving of St. George in body armour, tunic, and cloak, showing stiffening of attitude and loss of naturalistic form as compared with the figure on the right. At the top centre the carving, from an ivory casket in Troyes cathedral, France, illustrates the end of a wild-boar hunt, a popular pastime with the Byzantine court. Below it is a beautiful jewelled chalice, which is in St. Mark's, Venice. On the right is a delicate ivory carving of the archangel Michael, which dates from the 5th century, and is in the British Museum, London. One feature of Byzantine art is its lack of statuary, of which early Christians disapproved.

by hordes headed by princes of Scandinavian origin. Bulgars and Magyars added their pressures. By 959 the empire was little more than a shoe-shaped piece of the foot of Italy, the southern half of the Balkan peninsula, and Asia Minor; but a succession of soldier-emperors made that vestige secure and restored the Danube frontiers for a while. In 1048 the Seljuk Turks assaulted the eastern provinces, and thereafter Asia Minor was gradually lost.

In 1081 the emperor Alexius I was driven to ask help from the west; in 1096 the undisciplined armies of the First Crusade arrived in his dominions. Alexius sent them across to Asia: when in 1099 they captured Jerusalem he was re-establishing Byzantine power in parts of Asia Minor. The uneasy association of his successors with the rapacious chivalry of the west continued until 1204, when the Venetians succeeded in diverting the whole Fourth Crusade against their trade rival. French, Flemings, and Italians landed at Constantinople, and finally stormed and sacked it. They found a beautiful city with paved and well-lit streets, with superb palaces and churches, fine hospitals, theatres, libraries, schools, parks, arts and industries, and well-organized police; they made of it a smoking shambles two-thirds destroyed, from which, or in which, three-quarters of the population had fled or perished. Their barbarities disgraced for ever the name of crusader, and dealt Europe a wound from which it has never recovered; throughout its fifth and last phase the Eastern Empire was doomed.

Alinari

BYZANTINES AT A ROYAL BANQUET

Court life at Constantinople (now Istanbul) in the heyday of the Byzantine Empire was strictly governed by a Book of Ceremonies. This finely-wrought mosaic, which shows an emperor and empress at table, is on the walls of the Baptistery in St. Mark's, Venice.

Baldwin of Flanders was elected emperor by his fellow-commanders, and until 1261 he and his successors held together a shred of territory, the so-called Latin Empire of Byzantium. The Greek emperors of the house of Palaeologus had no chance to restore Byzantine greatness. Turks and Serbians closed in; the emperor John V became the vassal of the Ottoman Sultan Murad I, whose son Murad II besieged the city in 1422 and was repulsed. In 1440 the emperor John VII desperately concluded a union between the eastern and western Churches, but his subjects refused to honour the agreement. The west would not move to save the city, and Venice was blind to her own danger. Pope Nicholas V tried to collect a fleet, but only three Genoese ships arrived in time to help the garrison when in 1453 the sultan Mohammed II attacked by land and sea. His great artillery-train battered a way through the walls. On May 29, 1453, the final assault was made; the heroic emperor Constantine XII died fighting in the breach, and the barbarian night of Asia shut down on the ruined gateway of Europe.

It was a Tuesday, and Tuesday is still regarded in Greece as unlucky for the beginning of any new enterprise. The learning and culture of Byzantium had long begun to flow westward and to nourish the art and literature and science of new kingdoms in Europe, but much of Classical antiquity was then lost for ever. Besides the great churches, Byzantine bas-reliefs in ivory and metal, enamels, paintings on parchment, and goldsmiths' work remain as evidence of the technical skill and grandeur of conception of Byzantine artists. The imperial gold coin called the bezant was current in Byzantium and Europe from the fourth century to the fifteenth; in heraldry, the charge of a plain gold disc is still called a bezant. The double-headed eagle device of the emperors of Byzantium passed to the rulers of Russia, for Ivan III, Grand Prince of Moscow (1462–1505), had married the niece of Constantine XII; their grandson was the first tsar, Ivan the Terrible. Hence arose the proud claim of Moscow to be called "the Third Rome."

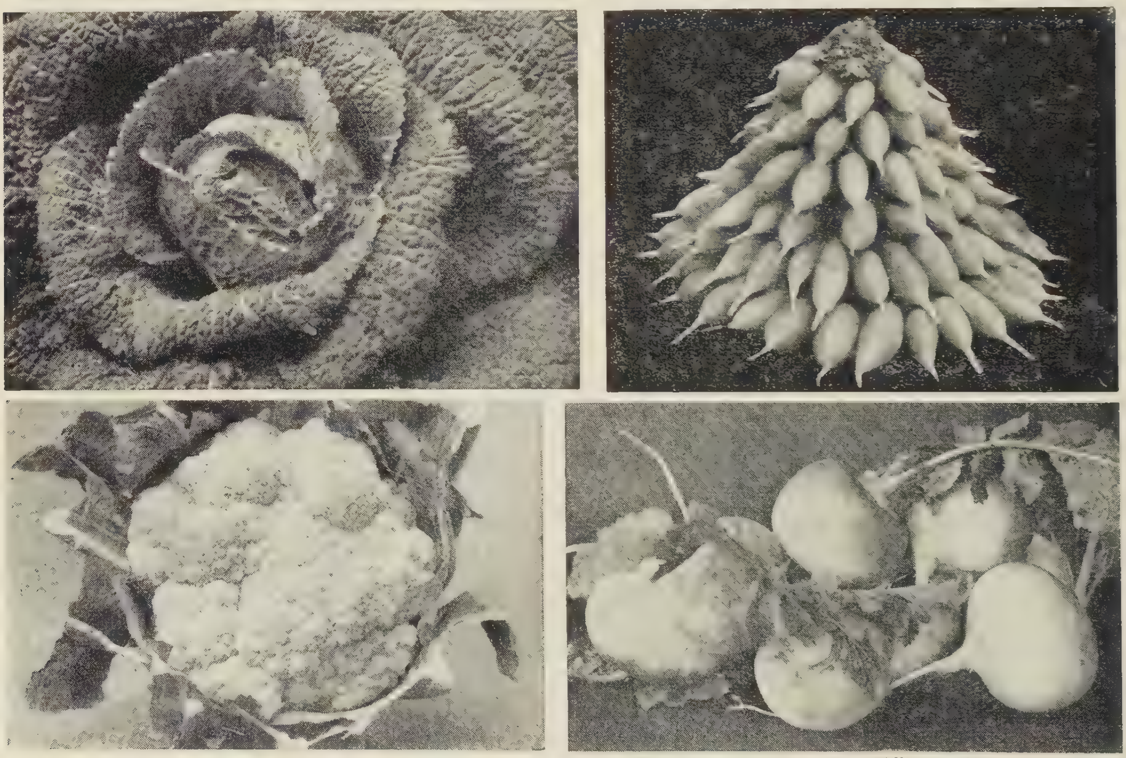
C

Cabbage. A smooth-leaved seaside plant called *Brassica oleracea*, the wild cabbage, looking like weedy kale, is the ancestor of our cabbage, cauliflower, broccoli, Brussels sprouts, kohl-rabi, and kale. These useful vegetables are rich in mineral salts and contain vitamins B and C. From the wild field cabbage, *Brassica campestris*, turnip, rape, and swede have arisen. All are members of the wallflower family, *Cruciferae*, and to the same *Brassica* section of that family belongs one kind of mustard.

The cabbage in its first season is a huge bud, storing food in its short stem and overlapping leaves. If left in the ground for a second season, the bud opens, a flowering stem comes up in the centre, and the yellow flowers produce seed pods, after which the plant dies. Brussels sprouts, which came from near Brussels, are really special forms of cabbage in which the stem grows upward and the tiny buds seen in a cabbage just where the leaves join on are much enlarged to form the sprouts. Food is stored in them as well as in the ordinary leaves.

A cauliflower is a cabbage in which the flower head remains for a long time in the bud stage and forms much larger and earlier than in an ordinary cabbage. In these hundreds of white flower-buds and their stalks much nutritious food is packed. Broccoli is like a very stretched-out cauliflower, and kale is like a stretched-out cabbage with smaller buds than Brussels sprouts. Kohl-rabi is like a cabbage with small leaves and a huge, turnip-shaped stem. The cabbage itself has produced many varieties, including the curly-leaved Savoy, the huge, pale, tightly packed "drumhead." and the dark red cabbage often used in pickles. Enterprising cooks find that this red kind makes a pleasant change from the green as a table dish.

Even in winter, cabbages and sprouts can be obtained fresh, and summer drought does far less harm to cabbages than to most vegetables. Raw shredded cabbage is delicious in salad. The old-fashioned habit of cooking it with a pinch of soda to keep it green was bad, for soda destroys vitamin C. A pinch of salt does no harm, and the shorter the boiling the more nourishment remains.



Williams; Abbing and Maltby

THEY ALL BELONG TO THE CABBAGE FAMILY

All these plants are members of the *Cruciferae* or cabbage family. The plant with wrinkled leaves (upper left) is known as the curly cabbage or Savoy ; the closely-folded, pale green centre is the best eating and is called the heart. Radishes (upper right) are grown for the root, tasty and tangy with salt. The cauliflower (lower left) is a cabbage that has been carefully bred until it developed a head of delicately flavoured flowers. Another relative is the turnip (lower right).

Cabinet. In the British Parliament, when an important question is to come before the House of Commons, all eyes are turned on a little group of men who occupy the front benches in the House at the right of the Speaker. These men will propose the government policy, for they, with other ministers in the House of Lords, form the Cabinet.

In former times it was the Privy Council (see article) that tendered the Sovereign advice on high and secret matters of state. This was a large and clumsy official body, which gradually lost this function to an inner ring of advisers called the Cabinet Council, from its practice of meeting in the king's cabinet, or private apartment. The Cabinet for long remained a more or less informal body: it was not until 1916 that a Cabinet secretariat was instituted and proper records kept.

The Cabinet, then, is chosen by the prime minister from leading members of the majority party, or from parties that support him, in both Houses of Parliament, as a close group of advisers on policy. Peace-time cabinets are composed of 15–20 members, usually heads of great government departments such as the Chancellor of the Exchequer and the secretaries of state for Foreign Affairs and the Home Department (commonly called the Home Office). The composition varies, however, and the Cabinet must necessarily leave out some quite important ministers if it is not to become too large and unwieldy.

In a constitutional monarchy, in which the king or queen must take ministers' advice, the Cabinet is the real ruler, and within the Cabinet the prime minister is supreme. He appoints members and may compel a member to resign: he actually "suggests" resignation, but if his suggestion were not followed, the prime minister would himself resign and all the Cabinet offices would then become vacant; the government would fall.

The Cabinet is responsible to Parliament, *i.e.* it must account to Parliament for its actions and it requires parliamentary support; but the Commons, if hostile, cannot vote any individual member out of office: it must turn out the whole Cabinet. Cabinet responsibility, to both Crown and Parliament, is collective; this means that on policy, any member speaks for all; and all support each member.

The system of responsible Cabinet government has been adopted by the self-governing nations of the British Commonwealth, such as Canada, Australia, and New Zealand, and by other nations following British democratic forms. In the U.S.A. the Cabinet functions quite differently. Its members are the heads of the great government departments appointed by the President. Cabinet ministers are individually responsible to him alone and not to Congress. Members cannot be members of Congress and can be dismissed at the President's pleasure.

SENDING TELEGRAMS UNDER *the* SEA

Cable. When an electrican talks of cables, he generally means the heavy, insulated wires used for carrying electric power from generating stations to houses and factories. But to most people "a cable" is a message that has been telegraphed (*see* TELEGRAPHY) along wires laid under the sea.

In the 1850s it took at least three months for a message to travel between Britain and Australia, for the only way to send it was by ship. To-day a business man in London can telegraph to a friend in Sydney, 12,000 miles away, to ask the price of wool, and can have an answer in a few minutes. Actually it takes longer to write out the message than it does to telegraph it along the 12,000 miles of wire lying on the bed of the ocean.

Sending an electric current along a wire supported above the ground is much easier than transmitting it along a wire laid under water. Air is an insulator; that is, it prevents the current from leaving the wire along which it is conducted; whereas water is a conductor, so that if a bare wire were laid under the sea, any current passed along it would simply leak away into the surrounding water. Consequently the first and most difficult problem that had to be solved before a submarine telegraph cable became possible was to find some means of keeping the water away from the wire.

One of the first attempts to send an electric current along a wire laid in water was made in 1795 by an officer of the Royal Engineers who laid a cable under the river Medway, near Chatham, Kent. The wire was insulated by covering it with tarred hemp, and an electric current sent along it moved the needle of a galvanometer. Eventually, however, the water soaked through, and the current leaked away.

It was not until the development of gutta-percha (see article) on a commercial scale, about 1840, that the ideal insulating material for submarine cables became available.

After a number of unsuccessful attempts, the first really practicable electric telegraph cable for work under the sea was laid by an engineer of the old South-Eastern Railway Company. The cable, which was covered with gutta-percha, ran above ground from London to a point on the Kent coast, from which it was taken out to sea for a distance of two miles by a steamship called the *Princess Clementine*. Over this cable messages were sent between London and the ship at sea. It had been intended to link up with the French coast, but not enough money was available.

The following year, however, the first submarine cable was successfully laid along the bed of the English Channel between Dover and Calais. It consisted of a single copper wire covered with three coatings of gutta-percha. The first message was telegraphed from Dover to Calais on the evening of August 20, 1850, but a few hours later the service ended when the insulation of the cable was cut through by the rocky sea-bed in the neighbourhood of Cape Griz Nez.

This accident proved that a submarine cable must not only be well insulated, but that the insulation must be protected against damage by rocks and other objects on the sea bed. Accordingly a new and improved cable was laid in 1851 between

England and France. It consisted of four copper conducting-wires, and the gutta-percha insulation was protected by an outside layer of galvanised iron wires. It was 25 miles long, and the first signal, a message of good wishes from Napoleon III of France to Queen Victoria of Britain, was sent on October 17, 1851.

Unfortunately this cable had been in operation for only a few months when a French fisherman hooked it up with the anchor of his boat and cut it through with an axe because he thought it was a piece of seaweed. However, repairs were quickly made, and it continued to give good service for a long time.

Having overcome the main difficulties of laying electrical conductors under water, telegraph engineers were able to lay a number of short undersea cables connecting England with various parts of Europe. In 1852 an armoured cable was laid between England and Ireland. In a few years cables were telegraphing messages between Britain and Sweden, Denmark, and the Netherlands.

None of these was longer than 117 miles, so it is not surprising that a proposal to connect Britain and America was generally ridiculed. The length would have to be over 2,000 miles, and in places the depth would be nearly 3½ miles below the surface of the sea. Many telegraph engineers were certain that the task was possible, but just as many scientists were equally certain that it was not.

Cyrus W. Field (1819–92), an American financier, was convinced that a Transatlantic cable was possible, and formed a company which in 1856 laid the first link, a cable 85 miles long connecting St. John's, Newfoundland, with Cape Breton, Nova Scotia. Field then came to London and formed the Atlantic Telegraph Company to complete the cable from Britain to Newfoundland. Among Field's most enthusiastic supporters was William Thomson (1824–1907), later Lord Kelvin (see article), a British scientist who had made a special study of submarine telegraphy.

On Kelvin's advice a cable was made containing 340,500 miles of copper and iron wire twisted into strands covered with nearly 500 tons of gutta-percha and protected by an outer envelope of galvanised wire. It was decided to begin laying from both sides of the Atlantic at once, so half of the cable was stowed in a British warship, the *Agamemnon*, and the other half was loaded into an American warship, the *Niagara*. The plan was for one ship to sail from Ireland and the other from Newfoundland, paying out the cable as they moved towards each other. At a point in mid-Atlantic the ships were to meet, when the two ends would be joined together. But the *Agamemnon* had sailed only 400 miles when the cable broke, and the enterprise had to be abandoned.

Far from being discouraged, Field and his associates tried again in 1857. On that occasion it was decided that the two ships should meet in the middle of the Atlantic, join the two ends of

LAYING A CABLE ACROSS THE ATLANTIC

The second Atlantic cable was laid by the *Great Eastern* in 1866. Above is a contemporary painting by R. Dudley of the scene aboard the vessel. The *Great Eastern*, the largest steamship then afloat, was propelled by screw, paddle, and sail. It was afterwards used to lay the French Atlantic, the Bombay-Suez, and the fourth and fifth Atlantic cables.

the cable, and then steam away towards the opposite sides of the ocean, each unreeling its own end. Three times breakages occurred after only a few miles had been laid, and three times the joint was made again; but after a fourth break the attempt had to be given up.

Still undaunted, the pioneers started once more in 1858. The ships again met in mid-Atlantic, joined the cable, and set off in opposite directions. This time everything went according to plan, and on August 5, 1858, each ship reached its destination with the cable lying intact at the bottom of the Atlantic. Although the actual distance between Ireland and Newfoundland was only 1,640 miles, the cable was 2,500 miles long, to allow for the irregularities of the ocean bed. It had cost £225,000.

Nevertheless, all the expenditure of time, labour, and money was in vain, for three months after the laying the messages transmitted became fainter and fainter and finally stopped. This was because the cable's insulation had broken down, and when the engineers used a stronger current to try to increase the signal strength, the insulation was completely destroyed.

Failure of the 1858 cable meant that no one would advance money for another attempt, while the outbreak of the American Civil War (1861–65) ended America's interest in the project. In the meantime cables were laid in other parts of the world, while William Thomson (later Lord Kelvin) designed an improved and much more delicate instrument for receiving messages.

At last Field managed to revive interest in a telegraph line under the Atlantic. The Anglo-American Telegraph Company was formed, and on July 23, 1865, he and Thomson sailed from Ireland in the *Great Eastern*, carrying a new cable. This cable had a conductor made up of seven strands of wire, and it was twice as strong as any previously used. The whole of the cable was carried in the *Great Eastern* and was stored in tanks filled with water to prevent the insulation from becoming dry and brittle. Half-way across the Atlantic, the cable broke, and the *Great Eastern* had to return to Ireland.

Success at Last

Most men would have been disheartened by these repeated failures; but not Field and Thomson. On July 18, 1886, they sailed again from Ireland in the *Great Eastern* with yet another cable on board, and on July 27, 1866, the American end of the cable was landed at Heart's Content Bay, Newfoundland. Transmission worked perfectly, and the *Great Eastern* returned to Ireland. On the way back the cable lost in 1865 was dredged up from the bottom of the Atlantic and spliced to a new length on the *Great Eastern*. The end of this was safely landed on the Irish coast, so that there were then two cables between America and the British Isles.

Thereafter the methods of making and laying steadily improved, and a number of other cables were laid across the bed of the Atlantic. On July 23, 1869, the French connected Brest and Duxbury, Massachusetts; on July 3, 1873, the *Great Eastern* completed laying a third Anglo-American cable, and in 1885 a German Transatlantic cable was successfully laid. The first

Courtesy of the Postmaster-General

Flag worn by British Post Office cable ships. It shows Father Time watching his hour glass smashed by lightning; so symbolising the speed of the electric telegraph.

continuous cable between England and the American mainland was that laid in 1926 by the Western Union Company from New York to Cornwall *via* Newfoundland. The first high-speed co-axial cable, which can carry several messages at once at the rate of 2,500 words a minute, was laid in 1931 between England and Newfoundland *via* the Azores.

Atlantic Network

In 1952 there were 21 cables spanning the bed of the Atlantic Ocean between Europe and America. All but six passed along a high underwater ridge called Telegraph Plateau, which was discovered during the laying of the 1858 cable. The plateau is comparatively level and at no point is it more than two miles below the surface of the ocean. It is covered with a soft ooze in which the cables become bedded, but from which they can easily be grappled and raised to the surface for repair. Telegraph Plateau makes it possible to use shorter and lighter cables than would be necessary to stretch over the Alp-like surface of other parts of the Atlantic bed. On October 18, 1929, an underwater earthquake snapped 12 of the chief Atlantic cables and interrupted services for a period of six weeks.

During the development of the Atlantic network of submarine telegraphs, cables were laid under the other seas and oceans of the world. In 1870 Bombay was linked with Suez. This was followed by cables from Britain to Africa, from Africa to South America, from Great Britain to Australia and New Zealand, from Great Britain to the countries of the Middle and Far East, and from various European countries to N. and S. America.

Cable laying in the Pacific Ocean was much more difficult than in the Atlantic, because of the greater distances and greater depths. The first Pacific cable was laid in 1902 and connected Vancouver, Canada, with Australia and New Zealand. It is about 8,000 miles long, the span from Vancouver to Fanning Island being 3,600 miles. The cable was duplicated in 1926 to meet the demands of the increasingly heavy traffic. The second Pacific cable, which goes from San Francisco to Manila, was completed in 1903 at a cost of nearly £3,000,000.

In the 1950s there were throughout the whole world nearly 3,100 separate cables totalling some 345,000 miles. Only a few of these were long-distance telegraph cables, most of them being much shorter underwater telephone cables. There were, for example, 47,000 miles of submarine

WORLD'S BIGGEST CABLE-LAYING SHIP

H.M. Telegraph Ship *Monarch*, owned by the General Post Office, is the largest cable ship in the world, with a gross tonnage of 8,050. She can carry 1,600 nautical miles of cable stored in four large tanks of water. The pulley wheels on the bow are for raising or lowering cables. In 1955 and 1956 the *Monarch* laid the first Transatlantic telephone cables.

conductors. Round the gutta-percha or other insulation are wound strips of jute, which in turn are covered by a protective layer of galvanised steel wires. Finally comes a wrapping of tarred hemp to prevent corrosion by the action of the sea-water. In some parts of the world cables run the risk of damage by the teredo, or ship-worm, which bores its way through the hemp cords and lets in the sea-water. A wrapping of brass tape is used for protection against this.

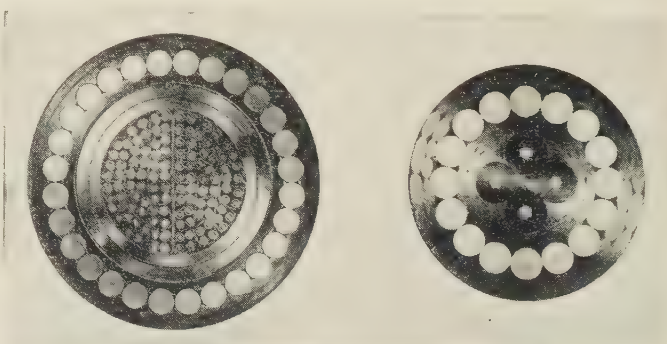
Submarine telegraph cable varies in thickness according to the depth at which it lies on the ocean floor. At the greatest depths, *e.g.* in mid-Atlantic or mid-Pacific, where there is comparative safety from marine animals, ships' anchors, or large rocks, it is seldom more than an inch in diameter and weighs about $1\frac{1}{2}$ tons for each mile of length. But where it lies in shallow water and is therefore more vulnerable, the cable is more heavily covered with galvanised wire and may reach three inches in diameter and weigh 10 tons for every mile.

Since 1870 cables have been laid by ships specially designed for the work. There are now about 50 cable ships in service throughout the world, the largest being the *Monarch*, which was built for the British government in 1945. The *Monarch* is pictured and described above.

cables, carrying telephone conversations between the British Isles, and between the British Isles and the countries of Europe. Fresh history was made in 1955–56 with the laying of two Transatlantic telephone cables. (For details, *see* TELEPHONE.)

Until 1928, British submarine telegraph cables were owned by a number of independent companies, but in that year a merger formed the Imperial and International Communications Company, and in 1934 the name of the company was changed to Cable and Wireless, Ltd. In 1947 the company was nationalised and taken over by the British government, although the name Cable and Wireless, Ltd. was retained. It operates 147,000 miles of submarine telegraph cables, but all British submarine telephone cables between the British Isles and to the Continent of Europe are operated by the General Post Office.

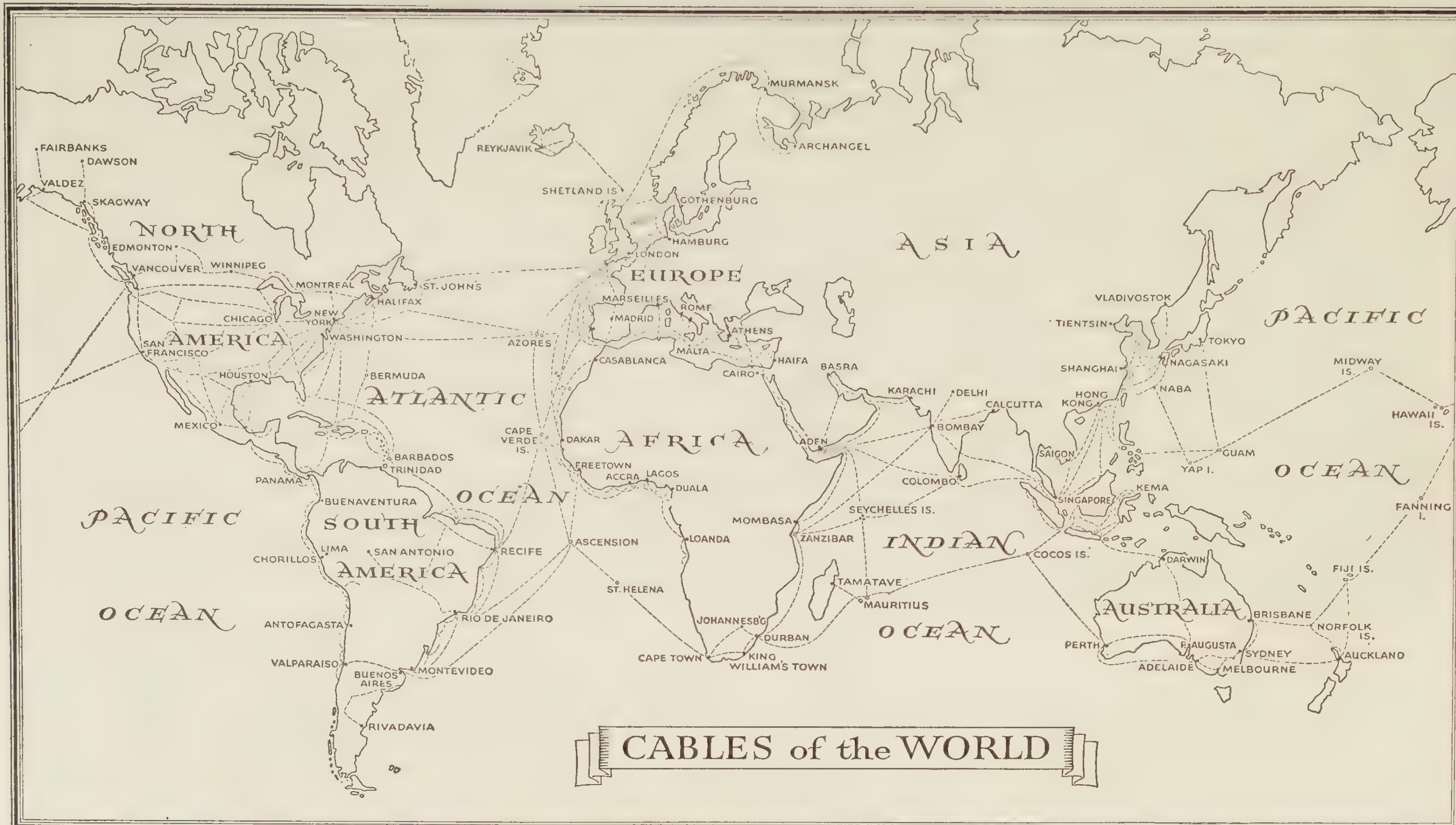
High-speed submarine telegraph cables as used to-day consist of a central copper wire about one-tenth of an inch in diameter, which carries the electric current. Long copper strips surround the transmission wire, and the core thus formed is wrapped round with a narrow tape made from a magnetic alloy of iron and nickel. The metal core is covered with gutta-percha, though a plastic material has been introduced for insulating the copper



Courtesy, Postmaster-General

CABLES OF TO-DAY AND YESTERDAY

Deep sea cables used to-day have many more conductors than had those of last century. The section on the left shows a cable laid in 1932; on the right is the one that was laid in 1891, having only four conducting wires.



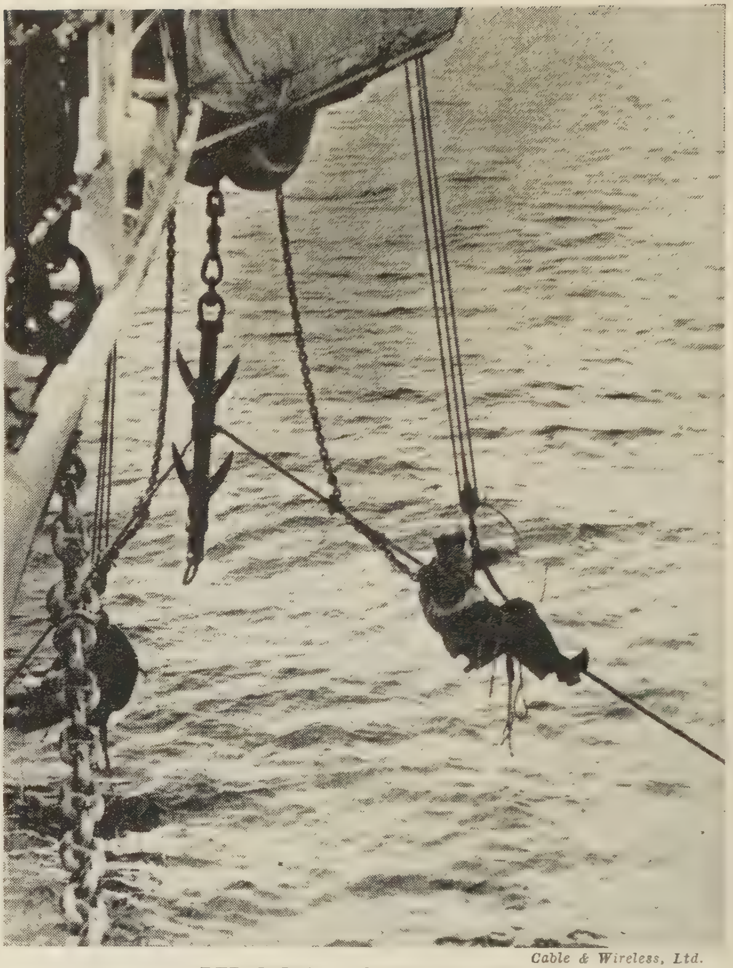
WORLD-WIDE NETWORK OF BRITISH AND AMERICAN CABLE SYSTEMS

In the 1850s it took at least three months for a message to travel between Britain and Australia, because the quickest way to send a message from one end of the world to the other was by ship. Nowadays a man in London can send a cablegram to Sydney, 12,000 miles away, to ask the price of wool, and can receive an answer in a few minutes.

Cable laying requires great skill and accuracy on the part of a cable ship's crew. Before a new cable is laid, soundings are made of the ocean bed along the proposed route and the exact depths are marked on a sheet. This makes it possible to avoid deep or rocky places where repair work would be difficult, and also establishes the amount of cable that will have to be laid.

During the laying operation the cable unwinds in the storage tanks and passes up to the ship's deck, where it passes over a drum which acts as a brake to prevent too fast a running-out. From the drum the cable passes through an instrument called a dynamometer which registers the amount of strain. It then passes into the sea by running over a grooved wheel called a sheave, which is mounted on the stern of the ship.

Sometimes the cable is ploughed into the sea bed to protect it from damage. This is done with a machine which it towed along the bottom of the ocean astern of the ship. In one operation it cuts a trench in the ocean floor, buries the cable to a depth of two feet, and then scrapes mud over it. A cable ship can lay about 200 miles a day, and while the laying is going on, electrical tests are regularly made to detect any breaks or weaknesses in the conductor wire. Every 24 hours the ship exchanges messages with a shore station to report progress, and these messages pass through all the cable stored in the ship's tanks.



Cable & Wireless, Ltd.

REPAIRING A CABLE AT SEA

Although they will last for as long as 40 years, deep-sea cables are sometimes damaged, and a cable ship then has to steam to the estimated position of the fault and bring the cable to the surface. The two men are repairing the casing after the position of the break has been electrically fixed.

Although they will last for as long as 40 years, deep-sea cables are sometimes damaged, and have to be fished up from the bed of the ocean and repaired.

When a fault occurs, the shore stations at each end of the cable estimate its position by electrical tests. A cable ship sails to the estimated position, and fixes her exact position by the sun or stars. She drops a buoy to mark her position and lowers a grapnel—a special type of hook—and drags it at right angles to the line of the cable.

An instrument on the ship tells the crew when the grapnel has hooked the cable, which is lifted on board and passed over sheaves on the ship's bow and stern. The ship then steams towards the buoy, and as the cable passes through the sheaves, electrical tests are made which eventually show where the conductor is broken. The damaged piece of cable is cut out, a new section is spliced in, tested, and dropped overboard again.

Cabot, John (*c.* 1450–98). On a May morning in 1497 a ship hardly larger than a fishing-smack sailed from Bristol with a crew of 18 on one of the most important voyages in history. The captain, John Cabot, born in Genoa, had settled in England, and was sailing under the flag of King Henry VII. He had been planning for several years to find a westward sea-route to Asia, so that the rich trade in Oriental spices, gems, silks, and perfumes could come direct to England instead of overland to the Mediterranean ports, and had been searching for islands that would make a half-way port of call; but when news came that Columbus had reached what everybody supposed to be the East Indies, Cabot decided to stop looking for half-way islands and to sail straight across the boisterous Atlantic Ocean.

On June 24 he landed on what he thought was an island off north-east Asia. It was probably, in fact, Cape Breton Island, and he was the first European to reach the shores of North America since the legendary Northmen. When Cabot returned to England, in August 1497, the king gave him £10 for having " found the new isle," awarded him a pension of £20, and advanced money for a further voyage.

In May 1498, Cabot set out with two ships and 300 men. A Portuguese explorer had sailed from

Iceland to Greenland, which he supposed to be the extreme north-east of Asia, and Cabot decided to try this route. He reached Greenland in June, and continued north until icebergs and a mutinous crew compelled him to turn south. Keeping to the coast, he passed Baffin Land, Newfoundland, Nova Scotia, and New England, but finding no signs of eastern civilization, and fearing his stores would run out, he returned to England in the autumn, and died soon after. The importance of his discoveries became evident later, when England laid claim to the whole of North America on the ground that Cabot was the first discoverer to reach the mainland of that continent.

Cactus. Many people collect those curious drought-resistant plants called succulents, and some call them all cactuses (or use the Latin plural, cacti), but this name should be kept for plants of the family *Cactaceae.* Until they flower, it is sometimes very difficult to distinguish cactuses from similar plants of the *Euphorbiaceae* family. Except for one kind in Africa and Mauritius, all true cactuses are natives of the dry regions in North, Central, and South America, and the West Indies. Ordinary plants in moist soil can afford to let some of their water supply evaporate from the pores in their leaves by a process called transpiration. Where rain is scarce, not only must this be avoided, but all possible water which the roots can get must be stored up. So most cactuses have long roots and manage without leaves. They make their stems do the work usually done by leaves (breathing and food manufacture) as well as storing water. The juicy stems, although they usually have tough skins, would be eaten by animals if it were not for their rows of prickles, sometimes very stout and sharp. One cactus group called *Pereskia* has kept its leaves, which help to store water. The group called *Opuntia*, including the prickly pear, has some members which have leaves when young. Most prickly pears, however, are a number of rather muffin-shaped spiny stem sections branching from one another. They have red or orange-yellow flowers and a juicy pear-shaped fruit which is good to eat. When taken from America to Australia these plants spread so rapidly that they covered thousands of acres of farm land, and the only successful way of killing them was by sending to Australia the insects called *Cactoblastis*, which eat them. In the Mediterranean countries, to which the same plants were transplanted earlier, they also became something of a pest.

In a few cactuses the stem and branches are three-sided with spines along the ridges, but in most

CABOT SETS OUT FOR THE NEW WORLD

This fine painting by Ernest Board, which is given a place of honour in the Bristol Art Gallery, shows John Cabot and his son Sebastian about to go an board their tiny ship, the *Mathew,* at Bristol to make the great voyage across the Atlantic in 1497, when he was the first European for centuries to reach the mainland of North America. The bishop has blessed the vessel, and the mayor is shaking the great navigator's hand, while sailors unmoor the ship.

they are shaped like very long sausages with many spiny ridges running lengthwise. The giant cereus of Arizona, one of these, grows as high as an average oak tree (60 feet). Birds nest in its clefts and the large red fruits are used for food. Another cereus is much smaller and can be grown in greenhouses. Its scented flowers have long drooping petals of white, pink, or red, and open at night, living a few hours only. On the thornless nopal cactus, *Nopalea*, grown in the Canary Islands, and on some prickly pears, is bred the insect *Dactylopius coccus*, from which comes the crimson cochineal. Alcoholic drinks can be made by fermenting cactus stems. (See colour plates facing pp. 160 and 161.)

Cade, Jack (died 1450). John Cade, commonly called Jack Cade, was an adventurer who gained brief notoriety as the leader of a rebellion in the reign of Henry VI in the stormy days that preceded the outbreak of the Wars of the Roses (1455–85). The people of England had many grievances against their king and his government at that time, and Jack Cade seized the opportunity to become a champion of popular liberty. About 20,000 followers, mostly yeomen and smaller landed proprietors of Kent and Sussex, joined him in marching from Ashford to Blackheath, which they reached on June 1, 1450. A force was sent against them, and the rebels retired; but the king's troops were defeated just outside Sevenoaks on June 7. Jack Cade and his men entered London on July 1. Making their headquarters at Southwark, Cade and his followers spent the daytime in the City. They murdered Lord Saye and Sele, an unpopular noble. But on July 4 the rebels began to loot houses, and on the 6th they found London Bridge closed to them by the citizens of London. There was a fierce battle on the bridge, and Cade and his rebels were driven away from the City. Very soon Cade became a fugitive, with a price on his head. On July 12, trying to reach the coast, he was found hiding in a garden near Heathfield, Sussex, and was killed while fighting to escape.

Cadet. Cadet is a French word meaning a younger son, and in olden times it was the custom in France and other countries to send the younger sons of noblemen to the army to train as officers. That is why in English the term cadet now generally means any boy or young man receiving naval, military, or air force training.

There are several kinds of British army cadet. Those who want to make the army a career as officers go to the Royal Military Academy at Sandhurst, Berkshire, after six months' service as privates. Boys who do not want to become regular officers but hope to get commissions in the Territorial Army can join the Junior and Senior Training Corps, founded in 1907 as the Officers' Training Corps, which are attached to the public schools and the universities. Boys can also join the Army Cadet Force, units of which are attached to schools and to boys' clubs. Boys join between the ages of 14 and 18, provided that they have their parents' consent. Camping forms part of their training. They learn the use of infantry weapons and how to read maps, are issued with army uniforms, and wear the badges of their local Territorial Army regiments.

Army Cadet Force Association

PRACTICAL TRAINING FOR ARMY CADETS

A briefing of section-leaders and signallers of a cadet unit, in the course of a training exercise. Map-reading is an essential part of training for boys who may one day become officers. The signallers are equipped with "walkie-talkie" apparatus. Sea Cadets and Air Training Corps have equally practical training.

Boys who are going to become regular officers in the Royal Navy enter as cadets at the Britannia Royal Naval College, Dartmouth. The Sea Cadet Corps, which was founded in 1899, is for boys between 14 and 18 who are interested in seafaring but who do not necessarily intend to join the Royal Navy. They wear naval uniform and have opportunities for practical training in ships. For girls there is the Nautical Training Corps. The Royal Marine Cadet Corps is for boys who intend joining the Royal Marines.

Young men who wish to become regular officers in the Royal Air Force enter the Royal Air Force College, Cranwell, as officer cadets. The Air Training Corps was founded in 1941 and accepts boys from the age of 14 who are interested in aviation. In 1946 the Army Cadet Force, the

GIANT CACTUS OF THE DESERT

In some great deserts of the world almost the only sign of life is the presence of cactuses. These vary in size and form, though most of them are prickly. Some put out one flower every seven years, others flower annually, some do not flower at all. This giant cactus, common in the deserts of Arizona and California, may reach a height of 60 feet. Some cactuses are edible, and most of them store water which, incidentally, is useful to travellers in the desert.

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QUEER CACTUSES AND THEIR LOVELY FLOWERS

Specially drawn for this work by E. C. Mansell

1. *Epiphyllum ackermanni*, native to Mexico. 2. *Cleistocactus strausii*, one of the best known of this genus. 3. *Opuntia dillenii*, a member of the Prickly Pear family. Some species of Prickly Pear are used as cattle food. 4. *Zygocactus truncatus*, sold under the name of Christmas cactus. 5. *Echinopsis eyriesii*, whose large, snowy flowers vary from white to pink. 6. *Gymnocalycium quehlianum*, popular with collectors. 7. *Astrophytum myriostigma*, a cactus without spines. 8. *Echinocactus horizonthalonius*, another cactus resembling a globe.

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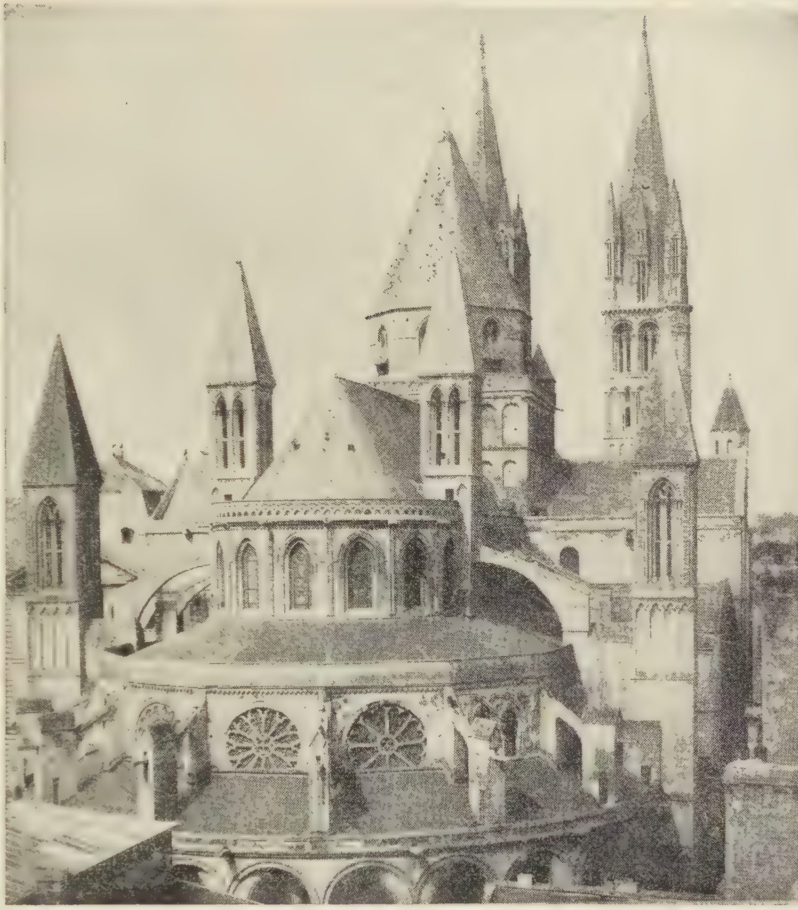
Sea Cadet Corps, and the Air Training Corps were organized into the Combined Cadet Force, although the uniforms and training remained distinct. The Junior Air Training Corps is for girls.

Besides navy, army, and air force cadets, there are those who train to become officers and seamen in the Merchant Navy. The most famous of the Merchant Navy cadet ships is the *Worcester*, in the Thames off Greenhithe (founded 1859). The *Conway* (founded 1859) was wrecked in 1953 and is now a shore school. The London Metropolitan Police Cadet Force was formed in 1951 for boys between 16 and 18 who want to make the police their career. Organizations such as the Red Cross and the St. John Ambulance Brigade have cadet corps for junior members.



ABBEY CHURCH OF ST. ÉTIENNE, CAEN

The church of St. Étienne, which also is known as Abbaye-aux-Hommes, was founded about 1070 by William the Conqueror and escaped damage during the Second World War. Another undamaged edifice is the church of Abbaye-aux-Dames, founded by William's wife Matilda. Caen suffered extensive damage in June and July 1944.

Caedmon (died *c.* 675). The language in which the earliest English Christian poet, Caedmon (pron. kad′mon), sang was what is now called Anglo-Saxon (or, as many scholars prefer it, Old English), and it was very different from the English of to-day. It is said that Caedmon was a cowherd at Whitby monastery and that there once appeared to him in sleep a being who said to him: "Caedmon, sing me a song." "I cannot sing," was the answer. "But you shall sing to me." "What shall I sing!" asked Caedmon. "Sing the beginning of created things," he was commanded. And, in his dream, he composed the poem beginning

> Nu scylun hergan hefaenricaes uard,
> metudaes maecti end his modgidanc,
> uerc uuldurfadur . . .

(Now ought we to praise the Founder of the heavenly kingdom, the power of the Creator, and His wise design, the deeds of the Father of glory . . .)

In the morning Caedmon told his dream to St. Hilda, abbess of Whitby, and he put into verse for her a part of the Scriptures. In recognition of his genius, he was made an inmate of the monastery and educated, and he spent the remainder of his life composing poems called Paraphrases, on the Bible histories and on other religious subjects.

The fame of Caedmon's work soon spread. "Others after him," as Bede tells us, "tried to make religious poems." He was the founder of a school of poets, who handed on the traditions of his work. It seems likely that many copies of Caedmon's poems were made, but what became of them there is no means of discovering.

A 10th-century manuscript, now in the Bodleian Library at Oxford, contains several poems that were once believed to be his work. It now seems to be almost certain that Caedmon did not compose the whole, but general opinion assigns to him the first and oldest part—*Genesis*, as it it called, which was the hymn on "the beginning of created things" that he was commanded in his dream to compose. Bede quotes this poem in a Latin version in his *History* (the lines above are taken from King Alfred's translation of Bede), and says that Caedmon also sang "of the terrors of the future judgment, and the horrors of hell-punishment, and the sweetness of the heavenly Kingdom." Milton may have derived some inspiration for his *Paradise Lost* from Caedmon's *Genesis*.

Caen, Normandy. When the Normandy invasion (see article) took place in the summer of 1944, the old town of Caen became the pivot of the attack. It had to be bombarded from the air, by field artillery, and by powerful naval guns, and in the process three-quarters of it was rased to the

ground. But Caen's recovery has been a fine example of intelligent and beaver-like activity.

Much delightful Norman architecture disappeared. The old Abbaye-aux-Hommes and the Abbaye-aux-Dames suffered little damage, but the celebrated spire of the church of St. Pierre was blasted; the Hôtel de Ville was gutted, and the University was reduced to rubble. Yet within ten years three-quarters of the devastated area had been rebuilt. Broad streets and avenues were laid out, flanked by high blocks of flats built in the white stone for which the region is famous, and keeping much of the Caen tradition. The ancient monuments were mostly restored, and the University was teaching nearly 3,500 students. Its new buildings, in the style of the great American universities, were formally opened in 1957.

Caen, capital of Calvados department, lies on the river Orne, nine miles from the Channel, with which it is connected by a canal (1842) emerging at Ouistreham. Settled by the Normans in 912, it became the home of William the Conqueror, and later his place of burial. It was twice occupied by the English, who founded the University in 1432.

The local limestone has been used in many notable English buildings; and other exports from the small port are agricultural products, wool, and iron ore. Caen has about 68,000 inhabitants. Dairy farming and fishing are carried on in the surrounding district.

Caernarvonshire. The wedge-shaped county of Caernarvon is situated at the extreme north-west of Wales opposite the island of Anglesey. The narrowest part, the Lleyn peninsula, juts out between Caernarvon and Cardigan bays. Most of the eastern and widest part of the wedge is taken up with Eryri or Snowdonia (see article), containing Snowdon (3,560 feet), highest mountain in the United Kingdom south of Scotland. On the north coast are the resort of Llandudno (below Great Orme's Head in one of two detached parts of the county east of the Conway); Conway town, with its 13th-century castle; Penmaenmawr; and Bangor, which has a cathedral and a university college. Caernarvon, the county town (population in 1951, 9,255), boasts a fine medieval castle. (See picture under Castle.) Built between about 1285 and 1322, it has been wonderfully preserved. Here in 1911 the young prince who was later to become King Edward VIII was ceremonially invested as Prince of Wales. To the north and west of the mountains are vast slate quarries.

The Lleyn peninsula has smaller hills (The Rivals, Yr Eifl, 1,849 feet) and is mainly agricultural. It has become popular with holiday-makers, with Nevin on the north coast and Abersoch and Aberdaron on the south as small resorts. Pwllheli, Criccieth, and Portmadoc are older resorts on the south coast of Caernarvonshire. Near Portmadoc is Portmeirion, a model village laid out by Clough Williams-Ellis as an experiment in town-planning.

Besides slate-quarrying and agriculture, industries include the manufacture of aluminium and electricity. The county is rich in prehistoric remains. Llewelyn the Great (d. 1240) was born at Dolwyddelan castle, and David Lloyd George, first Earl Lloyd-George of Dwyfor (1863–1945), was brought up at Llanystumdwy, near Criccieth. His grave lies there in specially consecrated ground on the bank of the rushing river Dwyfor.

The area of Caernarvonshire is 569 square miles, and the population in 1951 was 124,074. Three-quarters of the population speak Welsh.

The FOUNDER *of the* ROMAN EMPIRE

Caesar, Gaius Julius (102–44 B.C.). Though the daggers of assassins brought the career of Julius Caesar to an untimely end and left his life-work unfinished, he stands as one of the few men who have changed the history of the world. Had he not shown strength of character, determination, bravery, and skill, Rome would have left later nations without a model.

Brilliant in war, scholarship, and statecraft, Caesar early became a favourite with the people of Rome. When he was overseer of the public games (65 B.C.), he increased his popularity by preparing magnificent spectacles in the Great Circus for the pleasure-loving Romans, at the cost of a crushing burden of debt for himself. Then the dignified Roman senators would have laughed to scorn the suggestion that this careless man of fashion would some day be the conqueror of the world, the most powerful man in Rome. No one realized that there was shrewd purpose under his smiling exterior; that Caesar saw the rottenness of the existing government (extortion abroad, bribery and corruption at home, and utter laxity of morals), the need of a strong central power to save Rome from decay, that he felt himself to be the man to bring this change about. As a part of his plan he formed a political alliance with the two most powerful men in Rome, the wealthy Crassus and the popular general Pompey.

Caesar's election as Consul in 59 B.C. was the result, and the senators, who were now beginning to be alarmed, were glad to see him sent after his year of office to be Proconsul in Transalpine Gaul, the country now called France (then a part of the

Roman Empire). Here was Caesar's chance to prepare for the changes in Rome which he knew must come. While in Gaul he built up a well-trained army, subdued all Gaul hitherto unconquered, put down a dangerous rising under a leader named Vercingetorix, made a successful invasion across the Rhine, and twice led his army into Britain (55 and 54 B.C.), which, however, he made no attempt to conquer.

During those years of war and conquest Caesar worked with his men, fought with them, endured the same hardships. When at one time his soldiers mutinied at the appalling dangers they were called upon to face, Caesar shamed them into obedience by declaring that, if all others were to desert him, he would go on with the faithful Tenth Legion alone.

Crassus was now dead, and Pompey, jealous of the growing power of Caesar, had veered round to the side of the Senate. Caesar was commanded to disband his army, but, knowing that this would mean his political ruin, he refused. Instead, he led his loyal forces across the little river Rubicon, in northern Italy, the dividing line between the provinces and Italy proper, and marched against Rome. From this action, which amounted to a declaration of war against the Senate, comes the proverbial expression, to "cross the rubicon," used of a person who takes a decisive action that cannot be undone.

During the five years of civil war that followed Caesar's appearance at Rome he put down rebellions in Spain, decisively defeated Pompey at Pharsalus (in Greece), followed his enemy to Egypt, and himself came under the spell of Cleopatra, whose royal aspirations he espoused. He defeated Pompey's forces in Carthage and in Asia Minor. From the battlefield he sent his famous message to the Senate : "I came, I saw, I conquered" (*Veni, vidi, vici*).

Caesar returned to Rome in September 45. The marble bust of him in Naples Museum perhaps dates from this period, for though his hair began to thin in early manhood other features of this famous portrait are those of an ageing man. His face forms a remarkable contrast to the portrait of Alexander the Great that has come down, and the contrast is as sharp in many points of their characters. The Grecian beauty and grace of Alexander make the thin, painfully hollowed face of Caesar more startling, and the Roman is a more convincing representation of one who had suffered for long years the dread agony of war. Caesar, moreover, had the strain of facing for years of civil war all the great armies of his own country, and of organizing its political institutions. He was pale, with penetrating black eyes, tall for a Roman, and well built ; but perhaps his chief physical beauty was the domelike skull with its exceptionally fine lines, which he was so eager to hide with his laurel wreath.

Traits of Character

Like most educated Romans he collected works of art and had luxurious villas, and even carried to war pavements formed in little squares of mosaic work to be laid down in his quarters in the camp. He was a skilful horseman. Sometimes on horseback but oftener on foot, he went before the column, with his head bare in the burning sun or drenching rain, and would ride 100 miles in a day, swimming across streams when there was no other way of getting over. He wrote books in his litter on the march, and dictated dispatches on horseback.

He was habitually cautious in war, but sometimes carried out acts of seemingly reckless daring. His soldiers were allowed a good deal of licence, and when his enemies reproached him with their luxury he answered that they could fight well even if they were perfumed. He permitted them to wear valuable armour, as it encouraged their pride, and they were less likely to throw it down and run away. He won the devotion of his troops. Not only was he moderate and clement in the civil war, but in the end he allowed all Pompey's followers to return to Rome, and even went so far as to choose some of them to hold office.

That he was a great statesman is shown by

CAESAR THE STRONG

The impressive dignity and strength of will of Julius Caesar are discernible even in the sculptured stone of this famous statue in the Capitoline Museum, Rome Stern and forbidding, his features reflect his inflexible character and the strain of long, responsible office.

his grant of citizen rights to the people north of the river Po; by his sending Roman colonists to spread Roman civilization beyond the city limits; by his protection of the provincials; and by the lasting nature of his work as founder of the Second Monarchy, a restoration of the earlier rule in place of the republic ruled by consuls. His personal magnetism was strong, and he inspired liking and awe at the same time. Without a word of direction from Caesar, the leading men in Rome adopted instinctively the etiquette of courtiers.

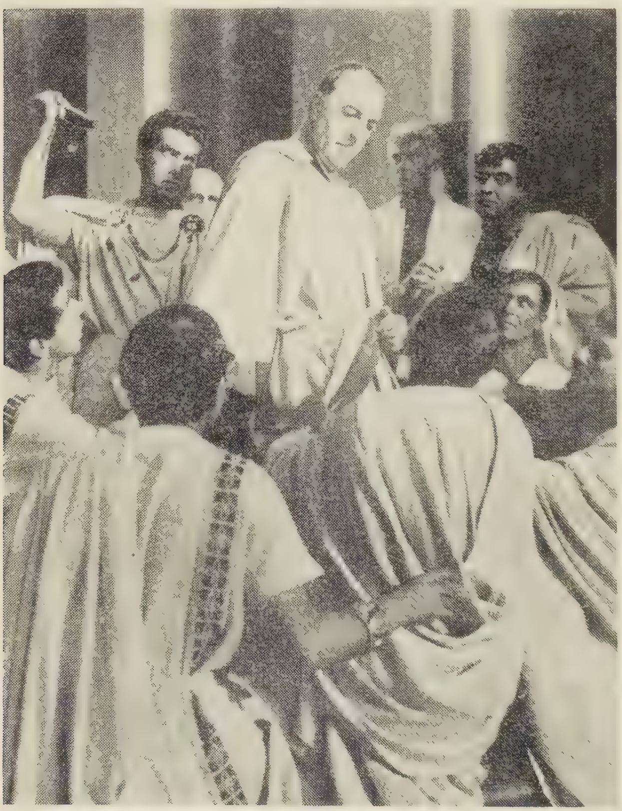
Caesar was now master of all the Roman world. Recognizing that the old institutions of the Republic were outworn and dead in all but name, he sought to build a new and stronger order in which the supreme power should be in the hands of one capable man. He had himself made dictator for life, took the title of Imperator, assumed the powers of all the leading offices of the state, and started many far-reaching and much-needed reforms. He reformed the calendar and divided the year into months which are substantially the same as those observed to-day. But there were still many of the old senators who could not tolerate the idea of one-man rule, even though it brought good government. They plotted to take his life.

The Senate was to hold a meeting on March 15 (called by the Romans "the Ides of March"), and the plotters determined that the dictator should die on that day. Among the conspirators were Caesar's friend, Marcus Junius Brutus, a Roman of such stern virtue that he was ready to sacrifice his friend and benefactor to what he believed to be the cause of liberty. Caesar was warned by a soothsayer to "beware the Ides of March," and his wife begged him to stay away from the Senate that day; but the conspirators persuaded him to attend.

As soon as Caesar was in the Senate chamber he was surrounded by the conspirators. At a signal they drew their daggers and attacked him. At first Caesar defended himself, but, when no one came to his assistance and he saw his friend Brutus with a dagger in his hand, he gave up the struggle, and with the words "You, too, Brutus!" (*Et tu, Brute!*) he fell dead at the foot of Pompey's statue. (The story of Caesar's death and its consequences are the subject of Shakespeare's play *Julius Caesar*.)

Thus Rome lost her greatest statesman and soldier, while the would-be saviours of the Republic did not accomplish their purpose, for 17 years later Caesar's great-nephew Augustus became Emperor of Rome. The next four emperors also belonged to the family of the Caesars, and the imperial name thus gained such dignity that it was retained henceforward as a title of honour, surviving to the First World War (1914–18) in the official designation (Kaiser, or Tsar) of the German, Austrian, and Russian rulers, and until the turn over to Communism in 1946, in that of the Tsar of Bulgaria.

Julius Caesar left his mark on literature as well as on history. In the midst of his busiest campaigns his unquenchable energy found time to record the events in which he was taking part. His Commentaries on the Gallic war and the civil war are familiar to every student of Latin, and are usually among the first books the student is set to read, because of their historical interest and their great simplicity of style.



ASSASSINATION OF JULIUS CAESAR

The conspirators, amongst whom were some of Caesar's own friends, set upon him in the Senate. Casca struck the first blow, and Caesar fell at the foot of Pompey's statue. The picture is from the film of Shakespeare's *Julius Caesar*, directed by Joseph Mankiewicz, with Louis Calhern in the name part.

Cairo. Although Egypt's capital does not go back to the splendours of the pharaohs, it has nevertheless a thousand years of history. Arriving by air at this great junction of airlines, it is easy to look down and see how commanding is the position of the capital city in the life of Egypt. It lies about 130 miles from the Mediterranean, at the apex of the great green triangle of fertile land formed by the Nile delta. To the south the Nile stretches away into the heart of Africa with only a narrow strip of green on either side. Beyond this narrow valley lies the desert, a limitless expanse of sun-baked rock and sand and naked mountain. Thus all traffic and trade up and down the Nile Valley must pass through Cairo, and it is also the centre for much that passes between Africa and the Middle East. Small wonder that the Egyptians use the same name—El Misr—for Egypt and for Cairo itself. It is the largest city in the whole continent of Africa and now has a population of something over 2,000,000.

Though Cairo was founded by Egypt's

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CITADEL IN CAIRO, CAPITAL OF EGYPT, SEEN FROM THE AIR

In the centre of the picture, and within the walls of the citadel, is the Mosque of Mehemet Ali, with twin minarets; to the left of the mosque are the mosque and tomb of Kalaun, dating from 1288. Situated on the right bank of the river Nile, the existing city was founded about 1,000 years ago. El Kâhira (the victorious) superseded four earlier cities, built between the 7th and the 10th centuries, which themselves took the place of an ancient Roman fortress.

Arab conquerors, the site has links with the country's great past. Twenty miles up the Nile lie the ruins of Memphis, where the pharaohs ruled about 5,000 years ago. For thirty centuries Memphis remained a great city, but then decayed. When the Romans began to rule in Egypt they built a fortress close to the Nile, a few miles from Memphis, at a place called Babylon. From its early days a Christian community lived there, and the site still exists as a Coptic quarter in Cairo. At last, in the 7th century A.D., Muslim armies struck out from Arabia. Babylon was captured by the Caliph Omar, and later a new Mahomedan capital was built on the spot where the Arab army had encamped for the siege. It was called El Fostat—"the Tent." Finally, A.D. 968, the Caliph El Muizz, advancing out of Libya, conquered Egypt, captured El Fostat, and built a new city near by called El Kâhira, from which the name of Cairo is derived. The French call it Le Caire.

So there grew up round the three sites of Babylon, El Fostat, and El Kâhira, the great medieval city famous in legend and history—dominated, as is modern Cairo, by the citadel built about 1177 by the Saracen leader Saladin. It stands on a spur of the Mokattam hills and above its walls rise the great dome and the two slender minarets of the lovely alabaster mosque built by Mehemet Ali, the founder of modern Egypt, who ruled from 1805 to 1849.

From the ramparts one can look down on the ancient walls and gates, the many beautiful mosques, the winding streets made dark by carved lattice-work balconies, and catch faintly the sound of the noisy, colourful life that teems in the bazaars. Deep in its heart, far from the modern part, is the thousand-year-old Mosque of El Azhar, greatest and oldest of Muslim universities, which is the chief teaching centre of orthodox Islam, and to which as many as 20,000 students come from all over the Muslim world.

Beyond the Oriental city the newer quarters, European in style, stretch out along the Nile. Mosques give place to concrete office blocks. The merchant in his booth is replaced by the department store. The streets are full of the roar of traffic, the shrieks of hooters from trams and motor-cars, the raucous shouts of street-sellers and passers-by clothed in every variety of Eastern and Western dress. Here are the cinemas and the

great hotels—some of which, including the world-famous Shepheard's, were damaged or destroyed during riots of January 1952. In midstream, across the Kasr-el-Nil bridge, lies the island of Gezira, a quiet residential area of broad avenues lined with flowering trees. Six miles away to the south-west, the Pyramids look down on the tram-lines which link them with the city.

Pyramids and tram-cars: the contrast is typical of Cairo, city of contrasts between the Eastern and the European way of life; between great wealth and poverty; between evil-smelling slums and noble thoroughfares lined with beautiful buildings; between the noise of the streets and the calm of the great river on which the big feluccas glide, carrying much of Cairo's trade.

That trade is extensive and varied. Gum and ivory, hides and ostrich feathers from the Sudan, cotton and sugar from Upper Egypt (in the south), indigo and shawls from India and Persia, sheep and tobacco from Turkey, and a great variety of American and European manufactures pass through the city. Many of its merchants are not Egyptians. In the streets you may hear voices of Greek, Armenian, Turk, Syrian, Cypriot, and many others. For this is one of the places where, in the past, Africa, Asia, and Europe have met and mingled, and Cairo is still a cosmopolitan city, even though not all foreigners are welcome to Egyptian "nationalists." After the Anglo-French landing in Port Said (Nov. 5, 1956) and their subsequent withdrawal, the Egyptian authorities sequestrated English and French commercial concerns—banks, large commercial houses, businesses, and schools. English and French nationals were expelled from Egypt. The various international clubs were "Egyptianised," and the capital for a time lost much of its cosmopolitan flavour. (*See* Egypt; Suez Canal.)

John H. Stone

EL AZHAR, MUSLIM UNIVERSITY

Originally intended as a mosque, El Azhar was completed in 972, but by 988 had become a university. Though its influence has waned with the marked decline in religious observance and the increasing materialism of Egyptian life, it is still attended by some 20,000 students.

TAILOR'S SHOP IN CAIRO

In the capital of Egypt many inhabitants still live much as people did centuries ago. These tailors are working in the street outside the dark cavern of their shop.

Caithness. The most northerly point of the mainland of Great Britain is in the Scottish county of Caithness. The actual northernmost headland is Dunnet Head, but John o' Groat's (two miles west of Duncansby Head) is usually taken as Britain's farthest north. Triangular in shape, Caithness has much bleak and barren moorland at no very great height above sea level. The county is almost treeless. It has many small lakes. To the south, mountains rise over 2,000 feet, culminating in Morven (2,313 ft.). However, there is a good deal of farming as well as sheep and cattle raising done in the more fertile areas. Fishing is the most important industry, and there is a fair amount of quarrying. The chief town is Wick (population in 1951, 7,161), which is a very busy place in the herring fishing season. The only other towns are Thurso and Lybster. Near Thurso is Dounreay, where an important atomic power plant has been built (see illustration in Volume 1, p. 309).

One peculiarity about Caithness is that many of the people are of Scandinavian origin. The language is almost entirely English, only one per cent. of the people speaking Gaelic. The population of the county was 22,705 in 1951; area, 685 square miles.

Calais, FRANCE. The nearest seaport to England, and on the Strait of Dover, Calais has a good harbour and is one of the chief ports for passengers between France and England, being on the shortest route. It is also a manufacturing city, being connected by canals with the northern coal-field of France and with Belgium. Lace-making, man-made textiles, and chemicals are important among its industries. By virtue of its geographical position, Calais has seen the start or successful conclusion of many cross-Channel adventures, including Blériot's pioneer flight in 1909 and Webb's pioneer swim in 1875.

Calais was an outpost of English power during the time of the Hundred Years' War. It was captured by Edward III in 1347 after a siege of 11 months, and, after all other English possessions in France were lost, came to be regarded as the English king's most precious possession abroad. This boast was written over one of the town gates:

Then shall Frenchman Calais win,
When iron and lead like cork shall swim.

However, it was recaptured by France in 1558, in the time of Queen Mary Tudor, who is said to have declared on her deathbed that the name "Calais" would be found graven on her heart. With this capture England lost the last of her possessions on the French mainland.

In the First World War Calais was an important Allied base and was frequently shelled from the sea and bombed. It was awarded the Croix de Guerre by the French government.

In the Second World War Calais was heroically defended for four days, May 24–27, 1940, by a small British force, in order to draw German forces from Dunkirk (see article), where the B.E.F. was being evacuated. It was then occupied by the Germans until 1944. Canadian troops reached it on September 20, and the Germans surrendered ten days later. By that time much of the town had been destroyed, but within a few years many historic buildings were restored, including the church of Notre Dame. The docks were busy again, and up-to-date town-planning had given a new look to the old city. Rodin's famous sculpture of the Burghers of Calais was saved from the bombardment, and now has a garden setting. The population of Calais in 1954 was 60,340. (For the story of the Burghers of Calais, see below illustration to HUNDRED YEARS' WAR.)

Calcium. Calcium builds bones, is essential to the smelting of iron, and is valuable to the farmer. But pure calcium, a soft white metal (symbol Ca, atomic weight 40), is not encountered in everyday life. All these tasks, and many others as important, are carried out by its compounds.

Of these the most abundant is calcium carbonate which occurs, more or less pure, as limestone, chalk, Iceland Spar, marble, and coral. In many parts of the world—for example, in Somerset and Derbyshire—whole ranges of hills consist of almost pure calcium carbonate. In America more than 160 million tons of limestone and chalk are quarried each year. Huge quantities are used in making cement and in the smelting of iron. If it were not for limestone, which combines with the impurities in the iron ore to form a molten slag which can be run off, the giant modern blast furnace could not operate. Either the ore would fuse with the clay—so defeating the whole purpose of the furnace—or the clay would bake into brick.

The oyster, in making its pearl, puts layers of calcium carbonate around a grain of sand. The story is told of how Cleopatra, to impress Mark Antony with her wealth, wagered that she could spend £150,000 on a single meal. The bet was taken, and Cleopatra, who was wearing two pearls each equivalent in value to half the sum, dropped one in a cup of vinegar. It swiftly dissolved—for the carbonate was attacked by the acid in the vinegar—and she drank the liquid. She was not called upon to do the same with the second.

In the white heat of the blast furnace, limestone breaks down into the lime (calcium oxide) and carbon dioxide is given off. This roasting of limestone to make lime is also an industrial process in its own right, the lime generally being "slaked" with water. As slaked lime (calcium hydroxide) it is used to make bleaching powder, for fertilising sour soils, for making soda caustic, and for converting raw hide into leather. Heated with coke in an intense electric arc, pure lime forms calcium carbide, the starting point for acetylene and for cyanamide, a nitrogenous fertiliser.

Now that world supplies of sulphur are running short, new ways of making sulphuric acid are growing in importance. One of these consists in roasting anhydrite, a form of calcium sulphate which occurs as a grey rock in many parts of

SITE OF JOHN O' GROAT'S HOUSE, CAITHNESS

On the north coast of Caithness, Scotland, and two miles west of Duncansby Head, is a place named after a house erected about 1600 by a Dutchman named Groot or Groat. John o' Groat's is usually regarded as Great Britain's "farthest north," though the actual northernmost point on the mainland is Dunnet Head, two miles to the west.

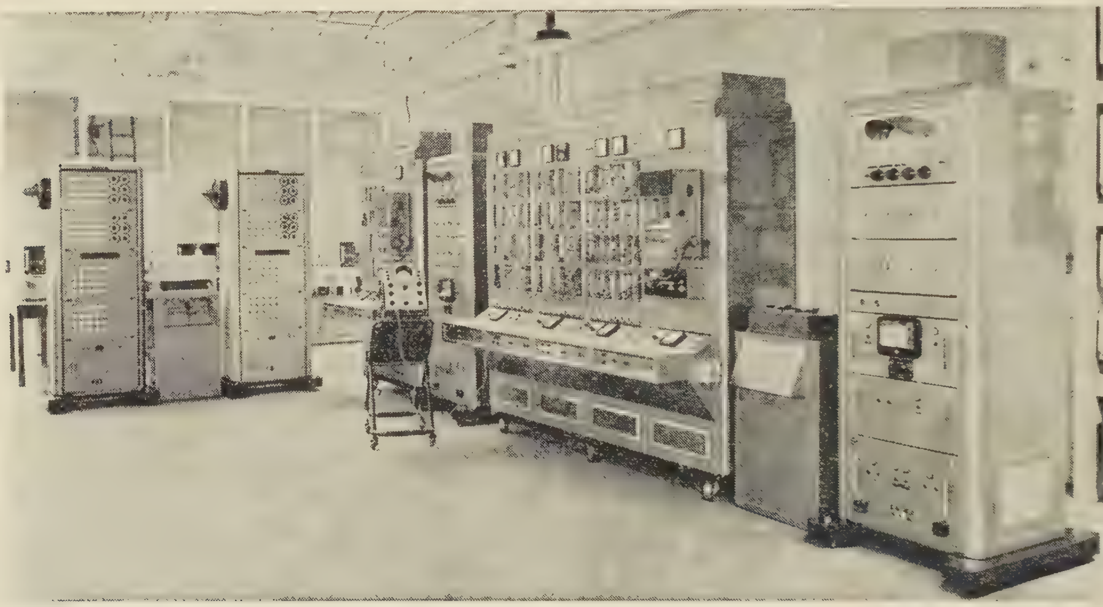
northern England, in a long revolving metal cylinder with coke and sand. The heat liberates sulphur dioxide, the starting point for sulphuric acid (see article), and cement is made from the residue. Anyhdrite is also used to make a fertiliser, sulphate of ammonia; here chalk is left over, which is mixed with ammonium nitrate to make yet another fertiliser, " Nitro-Chalk."

Calcium sulphate in some of its forms is known as gypsum and plaster-of-Paris. One of its less admirable properties is in making water " permanently " hard. Yet even this " permanent " hardness has an advantage—it is said to give the beer brewed at Burton-on-Trent its distinctive and (as some think) superior flavour.

The contribution of calcium compounds to agriculture does not end with lime and anhydrite. Plants are artificially supplied with the phosphorous they need in the form of " superphosphate." This is manufactured by the action of sulphuric acid on insoluble calcium phosphate rock, vast tonnages of which are imported from French North Africa. The acid renders the phosphate soluble, and thus usable by the crops.

Calcium phosphate is also found in the white residue left when milk boils over. Because for their first six months on earth everybody lives mainly on milk, it is as well that it contains this substance, which, through the presence of vitamin D, builds bones. Compounds of calcium are also essential for making the blood clot. All in all, these compounds are essential to human life.

MACHINES *that* WORK OUT COMPLICATED SUMS



Elliott Bros. (London), Ltd.

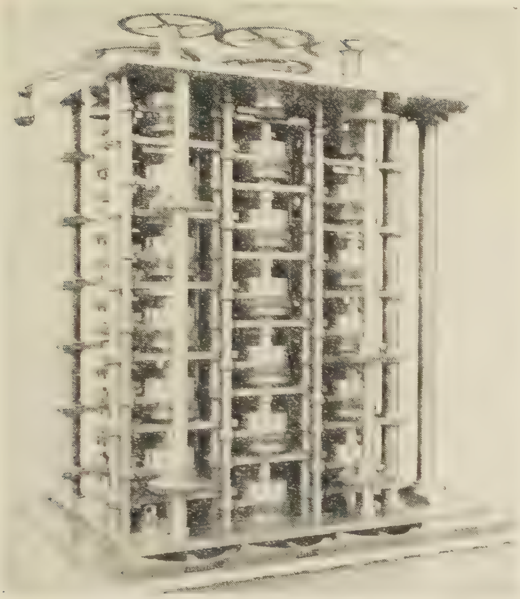
AN ELECTRONIC REACTOR COMPUTER

Computers, or calculating machines, are designed to solve accurately complicated and long mathematical problems in the shortest possible time. The computing system shown in the picture solves problems connected with the control of guided missiles, and is called a Homing Simulator. Electronic computers make calculations concerning atomic reactors and guided missiles at the rate of many thousands a second. If the same problems were worked out by mathematicians, the results would be out-of-date before they had been obtained. The first electronic calculating machine, containing 18,000 radio valves, was made in the United States in 1946.

Calculating Machine. Scientists and business men are constantly faced with elaborate calculations which are very boring and take up a lot of time. Calculating machines save all this trouble. Just as automatic looms make it possible to weave cloth rapidly, so does a calculating machine make it possible to solve sums more quickly and with less effort.

Modern electronic computers can do sums at the rate of many thousands a second, making calculations about such things as atomic energy and faster-than-sound rockets that would take any human mathematician so long that the results would be out of date before they had been worked out. The obvious value of this extremely high speed is seen in mathematical weather forecasting, wherein tens of thousands of facts and figures have to be considered and thousands of quite difficult equations solved. To do all this by human agency would take weeks, and it is no good spending a lot of time and effort working out a forecast for the weather of the Saturday before last !

The first calculating machine, as now understood, was invented in the mid-17th century. But man had long before invented various devices to enable him to calculate fairly easily. He soon found that the ten fingers on his hands were not sufficient. One of the oldest methods of counting



Science Museum, South Kensington

EARLY CALCULATING MACHINE

Charles Babbage's "difference engine," of which part is seen here, was intended for the working-out of mathematical tables. Babbage began it in 1823, but it had eventually to be abandoned through labour troubles.

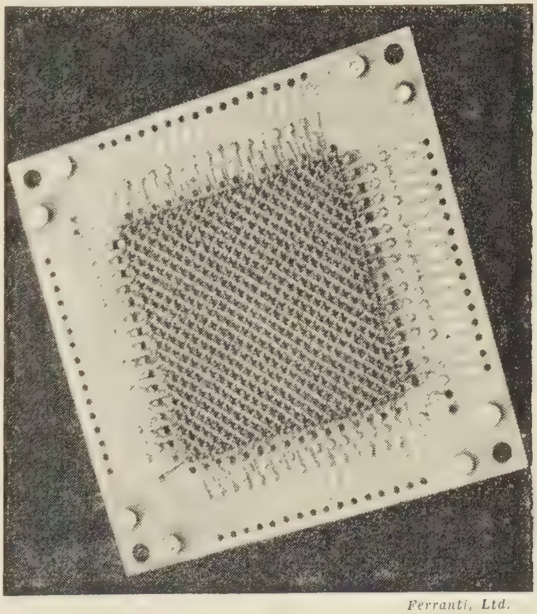
was to store pebbles in a bag; and indeed the word "calculate" is derived from the Latin word for "pebble." A modern equivalent of this process is the cricket umpire's trick of transferring a coin from one pocket to the other when each ball in an over is delivered. When one pocket contains six coins and the other is empty, then he knows that the over is complete. Another very ancient method of calculating was to cut notches in a wooden stick. These "tally sticks" were important articles of commerce and formed the ledgers of early traders. They were often split down the middle so that two halves with the same notches were obtained; one half was then used as a receipt for the goods counted on the sticks. This explains the expression that two sets of figures "tally," meaning that they agree.

The production of cheap paper and ink ousted these forms of counting quite early in the Western world, for writing on paper is far less laborious than cutting notches in a stick. In the Eastern world, where paper and ink are still not readily available, an instrument known as the abacus is used for counting (see illustration, Vol. 1, p. 228). The abacus is simply a series of horizontal wires on which beads are threaded (like those often seen on babies' cots), and counting is performed by moving the beads from side to side.

Pencil and paper arithmetic can, however, become very laborious, and it was the boredom of official accountancy that prompted a French boy of 18 to devise a machine which would add and subtract. It consisted of a series of gear wheels in many ways similar to those of a clock, and numbers were fed into it by rotating the spindles of various of these gears. This simple machine of Pascal, built in 1642, was followed in 1694 by one built by a German mathematician, Gottfried Wilhelm Leibniz, which would add, subtract, multiply, and divide.

It was not until 1812 that the first Englishman appeared in the field. This man, Charles Babbage, invented a much more ambitious machine, which he called a difference engine, meant for use with numbers as large as ten million million million. Babbage was given £17,000 by the government to build this machine, which he started in 1823. The mechanical construction was so delicate that he had to invent new tools and train workmen to build the special gears required. But after ten years spent on building the machine, an argument with his chief engineer led to this man's resignation from the job and the dismissal of the highly trained workmen. Babbage was never able to continue with this machine, and it was abandoned in 1842. He was not, however, dismayed by this apparent failure, and continued to produce many improved designs. The last design for a machine known as the "analytical engine" contained many of the principles which were applied only in the 1940s, a hundred years after their discovery by this remarkable man, who died in 1872.

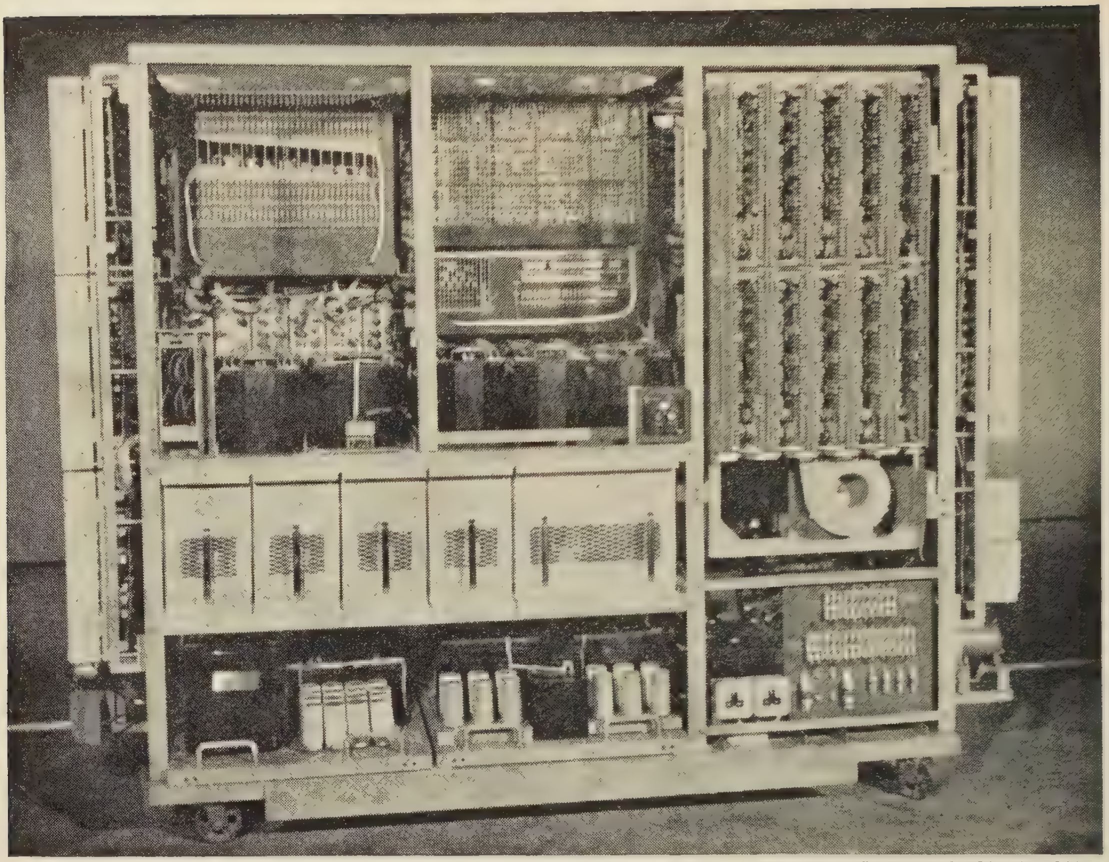
In the years following the death of Babbage, calculating machines were developed for the purposes of accountancy. Several firms, particularly in America and Germany, started to make machines based on the principles of Pascal and Leibniz. By 1888, for example, the Comptometer and the Burroughs machines were being marketed. These machines belong to a class known as "desk calculating machines," which in their modern form very closely resemble a typewriter. A typical desk machine possesses a series of keys similar to the keys of a typewriter. It if is desired to add together two numbers such as 348



Ferranti, Ltd.

CORE OF A CALCULATING MACHINE

The magnetic core is part of an electronic digital computer, and is used as a store in which all computations are made. A series of these cores form the "memory" of the machine, as it is called, and together will store 1,024 words, a word being equal to one number.



The British Tabulating Machine Co., Ltd.

ARITHMETIC UNIT OF AN ELECTRONIC COMPUTER

When the doors are opened, the complex wiring and the various valves and relays are exposed. This is the calculating brain of a general purpose computer, and it provides answers at speeds measured in milliseconds. Valves are gradually being replaced by transistors, which are not only many times smaller, but, because they use almost no power, do not become hot. **The transistor, a major electronic innovation, is about the size of a match-head.**

and 256, then the digits 3, 4, and 8 are typed into the machine in order by pressing the correct keys. The operator then feeds in 2, 5, and 6, the digits of the second number. When this is done, all that is required is that a special key marked + be pressed and the answer, 604, will be indicated on a row of dials. Other keys for multiplication (×), division (÷) and subtraction (−) are also usually provided. The sum just considered is so simple that it would hardly seem worth while using a machine to do it. However, it is possible to feed in very many numbers through the keyboard and obtain the total sum at the end of the operation. The answer is frequently printed directly on to a sheet of paper which may form a bill or receipt.

The actual arithmetical operation is a matter of seconds. The slowest part of the calculation is now the typing of the numbers into the machine. They have to be read from a sheet of paper by a typist, who has then to press the correct keys. Where a large number of figures is involved, the process is still slower than might be desired and it was to overcome the difficulty of input of numbers that Herman Hollerith developed the punched card in 1889. He was concerned with the census of the U.S.A., and he found that if instead of writing a number down on paper he punched a series of holes corresponding to that number on a card, he could design a machine which would automatically read that number. This invention has led to the development of the punched-card machine, which is considerably larger than the usual desk-type machine and works at a higher speed. Numbers are fed in as a series of cards, and the answers are punched out on similar cards which can be sorted. Thus it would need only a few simple operations to find out how many red-headed Roman Catholic grocers with three children are in the United States, provided that the data concerning hair colour, religion, occupation, and family had been fed in.

The punched-card principle has been extended into accountancy, maintaining firms' ledgers in this form instead of in the form of typed or written numbers. The punched sheets of the ledger, instead of being read by a clerk, are removed from the file and are placed in the calculating machine, which will automatically read all the information that is required.

The two types of calculating machine so far discussed are the desk machine and the punched-card machine; the majority of these are worked by a mechanical system of gears that are turned

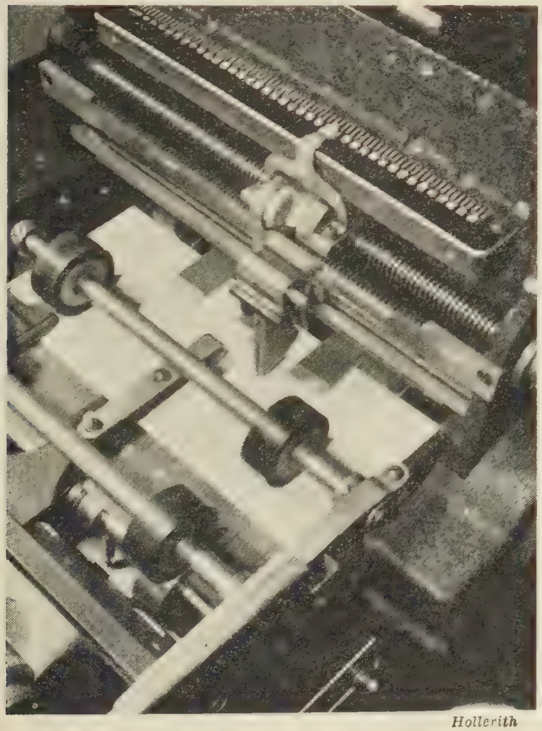
either by hand or by an electric motor which is controlled by hand. The speed at which they will operate is therefore fixed by the speed at which the gears will turn and the various linkages concerned will move.

Electric currents will move very fast indeed, and the first calculating machines so worked were made with the same apparatus as that used in an automatic telephone exchange. These machines consist of a large number of wires which can be connected to one another by little switches. These, instead of being operated by hand like an electric light switch, are operated by the electric current in another wire. These switches are called relays, and a machine using them is called a "relay machine." It can operate its own switches automatically by passing currents along the correct wires. The speed of these machines is very much greater than that of the purely mechanical type. The only moving parts are the contacts on the electric switches, which have to move a distance of only one hundredth of an inch instead of the several inches necessary in a desk machine. A number of these relay machines were built just before and after the Second World War. During that war, however, scientists produced new devices which could switch currents along wires without any mechanical movement at all. These new switches used radio valves, and the currents were used to control radar sets, guns, and many other instruments important in war-time. The calculating machine itself is important in times of national emergency for solving the many scientific and economic problems to which an answer is often urgently required ; and a certain number of scientists started to apply these new types of switch to the design of calculating machines. It was found possible to build a machine with no moving parts at all which would work at speeds far in excess of anything previously known.

Elliott Bros. (London), Ltd.

"FEEDING" A DIGITAL COMPUTER

A digital calculating machine deals with figures or digits; and numbers are usually fed into such a machine punched as holes in thin paper tape, the whole effect being not unlike a narrower kind of player-piano roll. The holes are detected by the "reader" in the machine and transmitted as electric impulses to the calculating mechanism for solving.

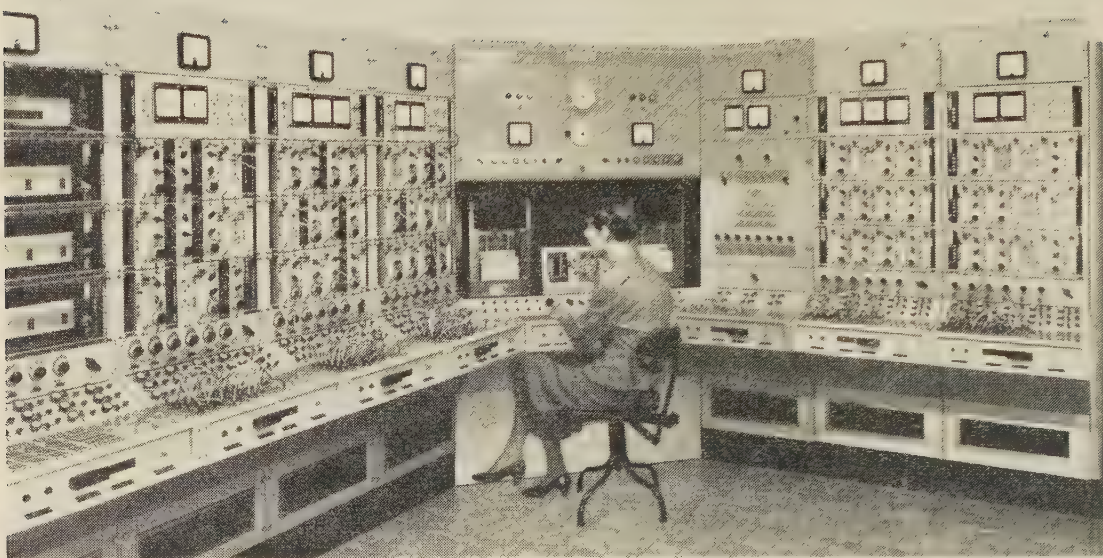


Hollerith

SENSING BRUSH OF A SORTER

To sort punched cards, a small metal brush is set in a predetermined position, and as each card enters the sorter, the brush detects the hole and completes an electrical circuit. The closing of the circuit results in the delivery of the card into the correct compartment on the machine.

The first of these electronic calculating machines, containing 18,000 radio valves, was built in America in 1946. Since then many thousands have been put into operation everywhere. These days, however, though many machines use more than 18,000 valves, computers have become much more compact. Valves, too, are now being replaced by transistors, which not only are many times smaller but also, because they use almost no power, remain cool. Transistors perform most of the functions of a wireless valve, but they are many times smaller —little bigger than a match-head. Instead of having inside them power-wasting heater elements with grids and plates to control the electron flow, they are made of minute pieces of solid crystal, germanium, or silicon, in which the movement of electrons is governed by the input signal. They consume very little power and are almost in-



Elliott Bros. (London), Ltd.

AN ELECTRONIC REACTOR COMPUTER

For solving the design problems of a nuclear power station an analogue computer, such as the one seen here, may be used. A computer of this type deals not with figures, but with such things as shapes, sizes, movements, pressures, temperatures, and strains. The analogue computer does not necessarily give its "answer" in figures, because it can draw graphs and pictures. Some can even show the "answer" as a three-dimensional picture on a television screen.

destructible. For some years they have been replacing valves in many applications. The first transistor computer was built in Britain by the Atomic Energy Authority for use at Harwell.

When they were first made, electronic computers were used mainly for complicated scientific work, but later, as more and more became available and their value to commerce and industry was realized, they were applied to all kinds of "bread-and-butter" jobs, doing them much more efficiently than could be done by a staff of accountants. One big catering firm uses a computer to work out how many thousands of ice-cream blocks are likely to be needed on a bank holiday if the temperature goes up to 80°, or how many cups of tea, rolls and butter, and plates of fish-and-chips they are likely to sell on any given day, so that their shops can be duly supplied.

Norwich Corporation was the first public authority to install a large computer to deal with its financial affairs. With 1,200 valves and ten miles of electric wiring, it cost about £50,000. Yet it works so fast and so efficiently that it saves the ratepayers £8,000 a year. Not only does it work out the rates that should be paid on each individual property in the city but it also types the demand notes (at 250 words a minute) and addresses them.

Modern computers are able to work so fast that often they can cope with more than a single firm can find for them. To save this waste, one of the big computer manufacturers, Elliott Brothers, allows firms to do their "sums" on a central machine. This machine is so versatile that in one week it did all these jobs: (1) it calculated the oil reserves remaining beneath the ground in the Middle East; (2) it carried out a programme of research into G.P.O. telephone cables and forecast how many more cables would be needed during the next few years; (3) it told a firm of map makers just how to draw the grid lines on a series of special navigational charts; and (4) it worked out a detailed report on the technical possibilities of a new atomic reactor. In its spare time the machine worked out all the details of wages, income-tax, and overtime and holiday money due in respect of the 600 staff of the company who owned it.

The mathematics involved in the four major jobs could have kept a team of twenty skilled mathematicians busy for almost a year.

Another machine, used by the British army, does such widely different things as deciding how many marks should be awarded to certain types of intelligence tests given to soldiers and making a country-wide check on the level of army stores. At the rocket-testing station at Aberporth, in Wales, many hundreds of calculations have to be made each time a guided missile goes up, to see how well or how badly it has behaved. Paper and pencil methods would take weeks, but the computer gives all the necessary facts in a few moments.

Many people call these computers "electronic brains," but of course no machine can think for itself, though in certain circumstances it may appear to do so. There is even one "brain" that is used to teach a second "brain" its job!

Computers can " make decisions " for themselves, but they have first to be " told " by their human masters how to do it. This is called " programming " the computer. Sometimes it takes several weeks to work out the programme that the machine must follow in tackling one single complicated problem. The great advantage is that once the programme has been prepared and given to the machine, it can go on doing similar problems at the same fantastic speed as long as is necessary.

There are two kinds of electronic computer. The one so far considered is called a digital computer, because it deals with *numbers* (or digits); the second, called an analogue computer, deals with such things as shapes, sizes, movements, pressures, temperatures, and strains, and shows just how they will all relate themselves in given circumstances. This analogue computer does not necessarily give its " answer " in the form of figures, for it can draw graphs and pictures of the result. Some can even show the answer in the form of a three-dimensional picture on a television screen.

Thus, if you asked a *digital* computer to describe Johnnie Brown, it would give the answer :— " Height : 4 ft. 8 inches. Weight : 8 stone 3 lb. Chest : 23 inches. Waist : 30 inches . . ." and so on. But the *analogue* computer would make a rough sketch of a boy with a fat tummy. Everything would be in proportion, though the actual measurements might not be there.

Guided missiles are mostly designed on analogue computers. If a designer, for instance, thinks it would be a good idea to change the shape of a fin or make the nose a little sharper, he puts the problem to the computer. Now, he tells his analogue machine, the present guided missile travels at 2,000 miles an hour, using so many thousands of lb. thrust, and reaches a height of 120 miles. What would it do if instead of using fin-shape " A," I used fin-shape " B " ?

The computer would then produce a whole series of results, relating all the performance figures to changes in design, so that the designer could sit at the machine and see, drawn on a chart or thrown on a screen, the result of the changes he contemplated. Then, having decided on the design, he could " fly " the missile (still, of course, only an idea on the drawing-board) and the computer would tell him how it should behave. Think of the millions of pounds and months of experiments a machine like that can save.

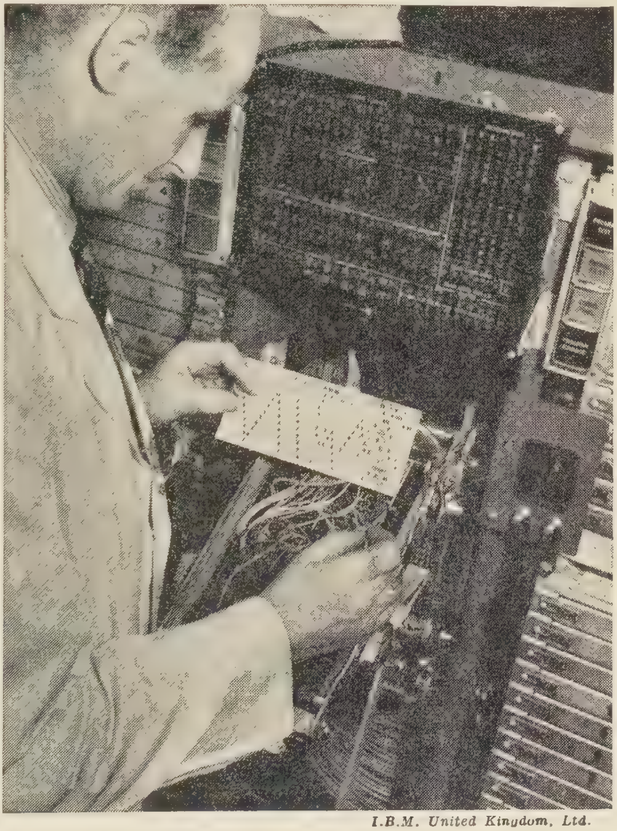
The analogue computer can do many other things, of course. It can pretend that it is an atomic reactor, so that a designer can try out the reactor under all kinds of conditions to make sure that it is safe. It is possible, in fact, to simulate an explosion in a reactor so that the physicists can see what it was that caused it to get out of control. The " explosion " on the computer will be the flash of a red light ; a real explosion would cost a great deal of money and be highly dangerous. The same kind of instrument can study the economics of a firm, or a household, or even the nation as a whole.

It can work out the probabilities of any given situation. If, it can be asked, the price of cheese goes up by fourpence a pound, how will that effect the sale of tinned herrings ? And it will answer logically and sensibly, so long as it has been given all the relative information.

The digital computer needs actual figures to solve its problems, and these are fed to its " brain " in the form of simple electronic impulses. To make it easier for the machine, the figures are turned into what is known as the binary code. Instead of having numbers one to nine, every number consists of a combination of one and zero. This is how the binary code is made up :

Ordinary Number	Binary Number	Ordinary Number	Binary Number
0	0	9	1001
1	1	10	1010
2	10	11	1011
3	11	12	1100
4	100	13	1101
5	101	14	1110
6	110	15	1111
7	111		
8	1000		

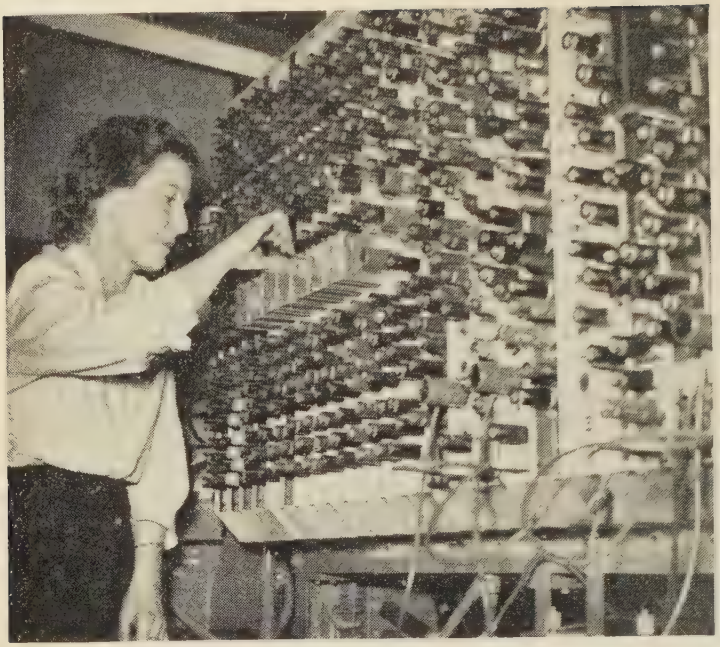
Using the binary code means that any number can be represented as a series of simple impulses.



I.B.M. United Kingdom, Ltd.

PLUG-BOARD OF A CALCULATOR

The plug-board of an electronic calculating machine can be compared to a telephone switchboard, because it can transmit and receive signals. The manner in which the operator plugs the board determines the series of calculations to be performed.



"MEMORY" OF AN ELECTRONIC BRAIN

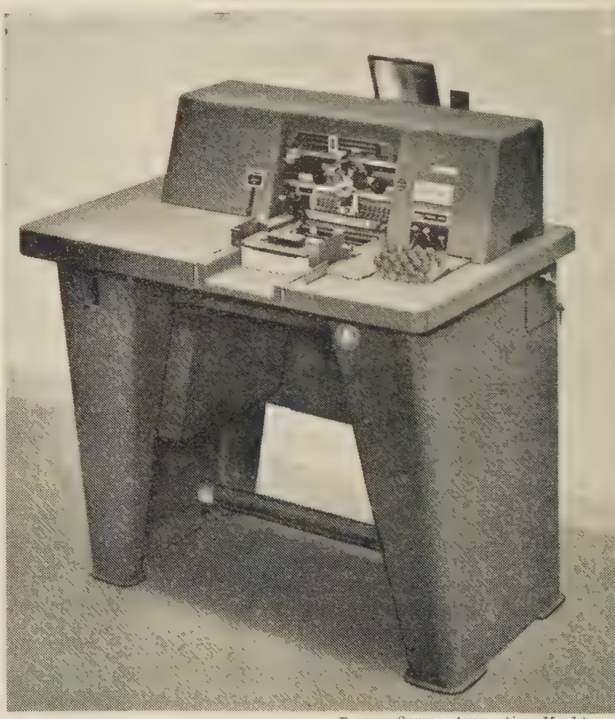
In use at the National Physical Laboratory, Teddington, this automatic computer, by means of radio valves and electronic techniques, works at incredible speed. A scientist is making adjustments to the "memory" section of the machine, which permits of a long series of calculations.

The figure one can be represented as "Switch On"; the figure zero can be represented by "Switch Off." This is much more reliable than trying to make a single signal represent a word. It may seem complicated that, for instance, the "ordinary" figure 11 is represented by the apparently bigger figure 1011, but electronically that represents the signal "On-Off On-On," and as each impulse occupies (possibly) only one millionth of a second, you can see that it does not take long!

The impulses that represent the figures, as well as a different series of impulses that represent the instructions to the machine, have to be "remembered" by the computer. This is done in several ways. One is by "storing" the impulse on magnetic drums. These, revolving at speeds of more than 100 miles an hour, are covered with a surface like the tape used in a tape recorder. A whole bank of "heads" alternately imprint impulses on the drum and then read them off again as they flash past. However many times the information is used, it is still there until the computer decides it is no longer wanted. Another "memory" consists of tubes of some substance such as mercury. The electronic impulse is turned into a physical pulse at one end, transmitted down the tube, and then turned back into an electronic impulse at the other end. Then it is returned, so that a chain of impulses can be cavorting up and down the mercury tubes, being "remembered," until they are needed. Information can be stored visually on cathode-ray tubes or it can be recorded on great rolls of film. The kind of "memory" employed depends for the most part on the job the computer is doing. By using new magnetic materials, a great deal of information can be stored in very little space.

"The introduction of electronic computers into science may prove not much less important than the introduction of mathematics in the seventeenth century," declared the famous scientist, Sir George Thompson.

Calcutta, INDIA. The city and port of Calcutta, capital of the state of West Bengal in the republic of India, is one of the greatest clearing-houses of Asiatic trade, as well as a major industrial centre. It lies on the left bank of the river Hooghly, about 86 miles from the Bay of Bengal. With its numerous docks and wharves it is a great port not only for ocean traffic, but for that of the many rivers which water the fertile plains to the north. This river traffic is carried chiefly in small native boats. Calcutta is also



Powers-Samas Accounting Machines

AUTOMATIC KEY PUNCH MACHINE

Accounting systems based on the punched card principle are much used by large industrial organizations. The cards are punched in the type of machine shown in the picture, each hole being part of a code that can be "deciphered" by a mechanical sorter at the amazingly high rate of 36,000 cards an hour

CALCUTTA : THE CHIEF CITY OF WEST BENGAL

A great port in the Republic of India and the capital of all India until 1911, when the seat of government was moved to Delhi, Calcutta stands on the Hooghly river, 86 miles from the sea. When the Indian Empire was divided into India and Pakistan in 1947, Calcutta became the chief city of the Indian state of West Bengal.

the terminus of several important railway systems, and is thus in every way the chief natural outlet for all the rich territory of Bengal (see article); but at the partition of India in 1947 much of this region became part of Pakistan, which has sought to develop its own port of Chittagong.

Calcutta leads the world in the manufacture of jute, which is extensively grown in Bengal. Cotton and other textiles are also important, as are the metal and engineering industries. The population within the boundaries of the city was 2,548,677 in 1951; but nearly 5,000,000 people are estimated to live in Greater Calcutta, which includes the town of Howrah and other districts on the opposite bank of the Hooghly.

The founder of Calcutta was Job Charnock, of the East India Company, who set up a "factory" (as every trading station of that company was called) in a village on the site in 1686–90. A few years later the company was given permission to defend the place, and the first Fort William, named in honour of King William III, was completed in 1702.

The grim episode of the "Black Hole" of Calcutta occurred in 1756, following the capture of Fort William by Surajah Dowleh, the Nawab of Bengal. The 146 English prisoners were forced into a cell in the fort 18 feet by 14 feet on a hot June night. The next morning only 23 were alive. The city meanwhile was plundered and burned, and it was not until seven months later that an English army under Clive recaptured it.

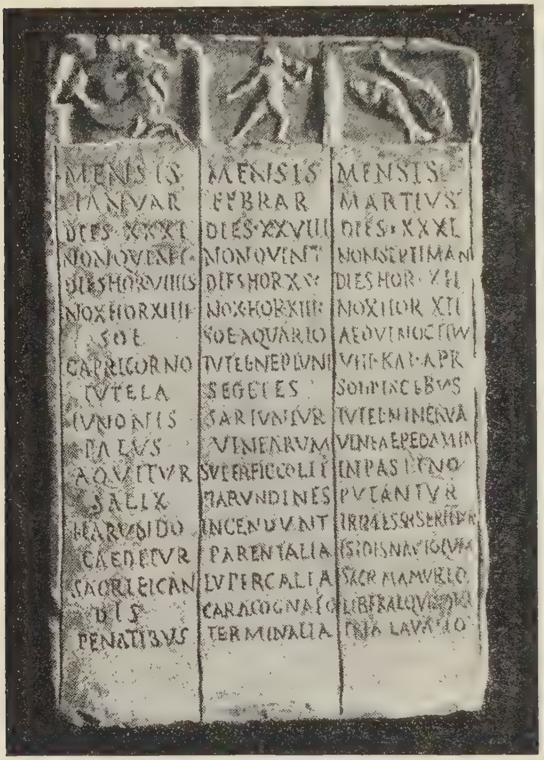
When Clive defeated the Nawab at Plassey, the province of Bengal came under British control. Rebuilding of the fort was completed in 1773, and in this year, with Warren Hastings as the first governor-general, Calcutta became the capital of British India. Thus it remained until the seat of government was transferred to Delhi, the ancient Mogul capital, in 1912.

Calcutta does not present the same magnificent and modern architectural prospect as greets the traveller in the newer city of Bombay. It recalls more readily the memories of men like Robert Clive and Warren Hastings, who laid the foundations of British rule in India, as well as of the great English merchants, or "nabobs," of the 18th century, such as are described in some of the novels of Thackeray, who was himself born and spent the first six years of his life in Calcutta. The city has pride in its parks, which were created on the sites of dismal swamps that took very heavy toll of lives in the past, being the breeding-grounds of malaria-carrying mosquitoes.

Around the Maidan, an open green space, which is larger than London's Hyde Park and Kensington Gardens put together, are some of the city's chief buildings, including Government House, the All-India Victoria Memorial Hall, and the Cathedral. The Memorial Hall is built of white marble and

surmounted by a fine central dome. Calcutta is an important educational centre. Here are situated a university, founded in 1857, and numerous colleges and high schools. There is also an art museum, where many rare and beautiful relics of India's ancient glory are exhibited.

During the war against Japan (1941–45) Calcutta was the chief Allied base for the Burma campaign. It was raided four times by Japanese bombers in December 1942 and several times thereafter, but suffered little damage.



National Museum, Naples

ROMAN FARMER'S ALMANAC

This is one of four stone slabs that made up a Roman calendar-almanac compiled in the 1st century A.D. On this slab is information covering January, February, and March. The middle column for February, besides giving number of days, and festivals, says that in that month fields are hoed, vineyards cultivated, and reeds burnt.

Calendar. Very early in man's history he began counting time by days and months and seasons, and so had the beginnings of a calendar. When the sun's seasonal progress was observed, men began to use the year as a unit of time.

The Greeks dated everything from the beginning of the so-called Olympic Register, a traditional list of the victors in the Olympic games starting with the year 776 Before Christ, according to our reckoning. The Romans counted time from the founding of their city in 753 B.C. The Mahomedans reckon dates from the Hejira, or flight of Mahomet from Mecca, Anno Domini 622. The Hebrew calendar reckons dates back to the Creation, calculated as having taken place 3,760 years and three months before the beginning of the Christian era. An extra (13th) month is inserted in the Jewish year seven times in a 19-year cycle.

Christian nations throughout the world now date events from the supposed birth-year of Christ. But this practice did not come into universal use until the life-time of Charlemagne (9th century), and a mistake was made which placed Christ's birth about five years too late. Thus, although everything is reckoned from the birth of Christ, scholars now say that this event occurred five years before the beginning of what is called the Christian era.

It must always be borne in mind when reckoning time or reading of happenings before the beginning of the Christian era (marked B.C.) that the longer ago an event occurred the larger is the number of the year, because, as time continued, the number of years before the birth of Christ grew less. For instance, the Olympic games of 776 B.C. were held 23 years *before* the foundation of Rome, which is supposed to have taken place in 753 B.C. The year 150 B.C. was 100 years *before* 50 B.C.; but the year A.D. 150 was 100 years *after* A.D. 50, because here the years are counted forward.

OLD AND NEW STYLES

The following table gives equivalent dates in both styles for the change-over period in 1752.

O.S.		N.S.
1751 Dec. 31	=	1751 Dec. 31
1751 Jan. 1	=	1752 Jan. 1
1751 Mar. 24	=	1752 Mar. 24
1752 Mar. 25	=	1752 Mar. 25
1752 Sept. 2	=	1752 Sept. 2
1752 Sept. 3	=	1752 Sept. 14

A further possibility of confusion lies in the fact that the change in the beginning of the year was made in Scotland in A.D. 1600. Documents written in English and dated between Jan. 1 and Mar. 24 (inclusive) in any year between 1600 and 1752 may thus bear two year-numbers for this reason.

The years falling between the year supposed to be that of the birth of Christ and the end of A.D. 100 are in the *first* century; from A.D. 101 to 200 is the *second* century, etc. The years 1901 to 2000 (inclusive) are in the 20th century. In reckoning time *before* the birth of Christ, the centuries are counted back from that event, just as years are. Thus 50 B.C. is the middle of the first century; "towards the end of the 3rd century B.C." is about 210 B.C.; "at the beginning of the 7th century B.C." would be about 690 B.C.

One of the difficulties in dealing with the calendar arises from the fact that the solar year cannot be divided exactly into months and days, because the time actually required for the earth's journey round the sun is 365 days 5 hours 48 minutes 46 seconds. Lack of precise knowledge of the number of days in the year caused all ancient calendars to depart sooner or later from the true seasonal ones.

Julius Caesar found that politics had muddled the old Roman calendar until the spring festivals were occurring in the actual summer months. In 46 B.C., on the advice of the astronomer Sosigenes, he fixed the year at 365¼ days, giving every fourth year, or leap year, an extra day. In this Julian calendar the months had their present lengths, the extra day every fourth year being

added to February. In early Roman days it was the duty of the head priest to proclaim (*calare*) each new month—whence *calendae* or *calends* (first of the month) and the word "calendar." The two other important days of each month were the "nones" and the "ides," which fell according to the following verse:

In March, July, October, May,
The Ides are on the 15th day,
The Nones the 7th, and all besides
Have two days less for Nones and Ides.

Though in the old Julian calendar every fourth year was made a leap year, the correction by a whole day every four years was too much. The difference mounts up to one day in 128 years; and by the 16th century A.D. the Julian calendar was 13 days behind the solar year, the sun crossing the equator in the spring on March 11. Pope Gregory XIII resolved to correct matters so that his reformed calendar conformed with the state of affairs as it was at the time of the Council of Nicaea, A.D. 325. He therefore directed that ten days should be dropped from the calendar in 1582, the day after October 4 being called October 15. To keep the calendar year and solar year together thenceforth it was directed that three times in every 400 years the leap-year arrangement should be omitted. This is accomplished by not counting as leap years the years ending in two noughts, unless they are divisible not by four but by 400. Thus 1600 remained a leap year, and the year 2000 will be one, but 1700, 1800, and 1900 were not. This arrangement will keep the calendar year and solar year together until the year 5000, by which time the difference will be one day.

The new calendar was called the Gregorian or New Style calendar, while the Old Style (O.S.) was the term applied to dates fixed according to the old Julian calendar. The Gregorian calendar was adopted almost immediately by Roman Catholic countries, but Protestant and Greek Catholic nations were slow to accept it. It was not adopted in Great Britain until 1752, when it was necessary to leave out 11 days. The days chosen were September 3-13 inclusive, so that the day of that year that would have been September 3 became September 14 (see table). The people were much concerned at this, and held meetings, and went about in processions crying, "Give us back our 11 days!" At the same time, New Year was changed from the end of March to January 1—another cause of confusion about dates in the early part of the year, so that you sometimes see a date given as February 12, 1751–52.

The Greek Orthodox Church keeps to the Julian calendar, and not until the revolution of 1917 did Russia adopt the New Style. This is why that revolution is called the October Revolution although (according to the Gregorian calendar) it occurred on November 7. Siam did not adopt the Gregorian calendar until 1940, making the Buddhist year 2484 begin on January 1, 1941, instead of on the following April 1.

CALIFORNIA'S CANYON

The glacier-carved walls of Tenaya Canyon, in the Yosemite national park, are almost a mile high, and Overhanging Rock is a popular vantage point for those with a head for heights.

California. This state, second largest in the American Union, lies on the Pacific coast between the Mexican border to the south and the state of Oregon to the north. (*See* UNITED STATES map.) It has a brilliant variety of scenery and climate. One can bathe in the morning in the great combers of the Pacific ocean and in the afternoon, after a fast drive along spectacular highways, one can ski in the mountains. The topography ranges from the Sierra Nevada mountains, which rise sharply from the coastal plain, to the Great and Imperial Valleys with their fertile agricultural lands. There are eighteen national forests and 41 peaks of over 10,000 feet. The highest point in California is the peak of Mount Whitney (14,595 ft.); the lowest is the famous Death Valley, 282 feet below sea level, a parched desert with temperatures of over 100 degrees, which has been a veritable death-trap to many travellers.

Explorers, including Sir Francis Drake, visited the coast in the 16th century, but it was only two centuries later that a permanent settlement was made, by Franciscan friars from Mexico. California became a province of Spain and later of Mexico, and the traditions of these Spanish Orders and their missions persist in place names and architecture. The state was admitted to the Union in 1850. It had been wrested from Mexico by conquest in the Mexican War of 1846-48, and

VAST ORANGE GROVES IN THE STATE OF CALIFORNIA

Though noted for its sunshine, much of California remained unproductive owing to the inadequate rainfall, but now extensive plains, which were once barren, have been transformed by irrigation and scientific cultivation, and yield an immense crop of semi-tropical fruits, such as oranges, lemons, grapes, peaches, and figs, as well as enormous quantities of vegetables. The mountains in the background are part of the Sierra Nevada, and between these mountains and the Coast Range lies the Great Valley of California, the chief cultivable area.

had received a sudden influx of population after the discovery of gold in Sutter's Creek in 1848. Thereafter California has remained an El Dorado for all in America and Europe who yearn for the sun, riches, and an easy life.

The building of the first great trans-continental railway, the Union Pacific, brought the state within overland reach of the other United States and replaced the long sea journey round Cape Horn. Wheat farming, lumber, and, above all, gold and silver mining, brought riches to the beautiful port of San Francisco, whose high Golden Gate suspension bridge spans America's gateway to the Far East. The city was rebuilt in three years after a disastrous earthquake in 1906.

In the 1880s large numbers of Chinese and Japanese labourers found work in the fields and mines of California, and their descendants, along with more recent Mexican immigrants, remain an important element in the working population. After the First World War still more people settled in the state, including many retired farmers from the Middle West. It was perhaps this elderly population, with modest means and ample leisure, which encouraged the growth of the various strange religious sects and popular cults that are still characteristic of the state.

In the 1920s the bright light and absence of rain made Hollywood the centre of the rapidly-developing film industry. (In later years the climate became less attractive, as industrial fumes caused much fog.) Hollywood is now a suburb of Los Angeles. Between the two world wars this city grew from a small village to a vast stretch of town more than a hundred miles across.

The greatest growth of the state came, however, with the Second World War, when the manufacture of aircraft became a major industry and there was a great boom in San Francisco's shipyards. Since 1945 both agricultural and industrial development have continued at a phenomenal rate. Between 1940 and 1950 the population increased by over 53 per cent. to 10,586,223.

California is now the largest producer in the United States of citrus fruits and fresh vegetables and of such allied products as canned goods, dried and frozen fruits, and wine. Cotton and sheep are other important products. Southern California's oilfields continue to make a major contribution to American oil needs. The film industry remains important, and now in television and radio Hollywood shares with New York the monopoly of purveying the nation's entertainment.

There are over one hundred universities and colleges in California, including the University of California, with more than 40,000 students. The Mount Wilson Observatory is one of the most important in the world, and this wealthy state is rich in other cultural endowments, such as symphony orchestras and art galleries.

Calvin, John (1509-64). One July evening in the year 1536 three weary travellers appeared in Geneva, in what is now Switzerland. They intended to pass the night at one of the inns of the town and to proceed the next morning on their way to Strasbourg. When Guillaume Farel, the reforming or Protestant minister of Geneva, heard that John Calvin was one of the party, he hurried to the inn and persuaded Calvin to stay in Geneva and help in forming a state which should be governed in accordance with strict Protestant religious principles.

Calvin had been obliged to flee from his home in France because he had turned against the Roman Catholic Church. He settled for a time in Basle, but Geneva was a better place for him to come to. It had accepted the teachings of the Reformation; it had won at the same time its independence from its feudal ruler and was a self-governing city-republic. Therefore Calvin could put into practice his ideas of a perfect state—ideas which had been formed during his years of study in French universities.

His theological treatise, *The Institutes of the Christian Religion*, had appeared in 1536. Whatever view may be taken of Calvin's teachings, this work is a masterpiece of thinking and of exposition. Its production by a man of 27 is astonishing. Few books have had such immense influence.

Calvin intended to make Geneva a "city of God"; it soon came to be known as the City of Calvin and the "Protestant Rome." Everyone was required to go to church on Sunday or suffer severe penalties. A man who swore "without necessity" was required to take off his hat, "kneel down in the place of his offence, clasp his hands, and kiss the earth." Silk dresses or hosiery, jewelry, and other adornments were forbidden. Such severe restrictions made Calvin and Farel so unpopular that within two years they had to leave Geneva. However, five years later they were recalled, and Calvin remained in Geneva, reforming every department of life there, including trade and social conditions, until his death. One of his achievements was the foundation of the University of Geneva. The greatest blot on his fame is his part in the burning of Servetus, a religious teacher who denied the doctrine of the Trinity.

Calvin's teachings—that all good is in Divine Grace, that the elect are chosen by God before they are born (doctrine of predestination), that all others are doomed to sin unless they save themselves by serving God in all things—spread among the Huguenots of France, Protestants of the Netherlands and Scotland, and Puritans of England. His Church system, with presbyters chosen by the congregation, was adopted later by Presbyterian churches.

JOHN CALVIN

This French leader of Protestantism in its conflict with the Roman Catholic Church reformed Geneva city morally and founded its university. He died there on May 24, 1564.

Cambodia. Cambodia is one of the three states forming the peninsula of Indo-China. It is bounded on the north by Siam and Laos, on the east by Vietnam, and on the south-west by the Gulf of Siam, having an area of 70,000 square miles and a population of more than 4,000,000.

There are three distinctive geographical regions: in the east a low undulating plain plateau; in the centre a continuous level plain, broken here and there by isolated hills and containing the two main waterways, the Mekong and the Great Lake (Tonle Sap); in the west the Elephant Range and the Cardamome Mountains. The climate is monsoonal, with summer rains and dry winters.

Cambodia is a thinly-populated country, three-quarters of it being covered by dense jungle forest, but where it can be cultivated the soil is highly fertile and yields several crops a year. Nearly all the people get their living from the land, and their lives have always been centred in their villages. Farming is carried on mostly on smallholdings; there are no large estates.

Rice is the staple food, and the crop amounts to 1,500,000 tons a year, some of it being exported. Pepper, cotton, rubber, tobacco, and soya beans are other important crops. Fishing is, next to farming, the chief source of income of the population, and Cambodian *platou* (dried fish) is much in demand in the countries of south-east Asia. The Great Lake, famous as a beauty spot, is one of the richest fish reserves in Asia. There is as yet little industrial development, and mineral resources have scarcely been exploited, though small quantities of iron ore are mined.

The only large towns are Pnom-Penh, the capital (pop. 350,000), Battambang, Kampot, and Pursat. The Mekong is navigable over most of its length and medium-sized ships can reach Pnom-Penh.

Racially the Cambodians are akin to the Siamese. They form the vast majority of the population, but there are also large foreign communities, chief among whom are the Vietnamese (330,000), who are mostly engaged in farming and fishing but also provide the labour on rubber plantations. Next are the Chinese (225,000), who make up the middle-class element and the trading community. Then there are Indians, Malays, and 5,000 Europeans, mostly French.

Modern Cambodia is heir to the once-flourishing Khmer empire (800–1400), which extended far beyond the present frontiers. It reached the peak of its power in the 12th century and vestiges of its greatness still remain in the form of many monuments, palaces, and temples. Chief among these is the temple of Angkor Vat (description and picture overleaf). In the second half of the 15th century Cambodian power declined and wars against Siamese and

WONDER OF CAMBODIA RESCUED FROM THE JUNGLE

For centuries the ruins of Angkor lay hidden in the dense jungle of northern Cambodia. Rediscovered in the 1860s, it is one of the most splendid examples of Asiatic architecture. Angkor was the ancient capital of Cambodia, and to the south of the city is the temple of Angkor Vat (top), which was designed for the worship of Vishnu. It stands in a moated park and is believed to date from the first half of the 12th century. Below, dancing girls attached to the temple are performing. The ruins are relics of the Khmer empire, which was founded by a people from India and ruled over the Malay Archipelago for some 600 years. The Khmers reached a very high stage of civilization before their empire was overthrown by Ayudhya's Siamese invaders.

CROWNING GLORY OF CAMBRIDGE UNIVERSITY

King's College Chapel, which was begun in 1446 and completed in 1515, has been described as the finest example of ornate Perpendicular architecture in existence. It is notable in particular for its vaulting, and contains some very beautiful windows of 16th-century stained glass. This picture was specially drawn for this work by Tom Chorlton.

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WHERE THE CAM FLOWS THROUGH CAMBRIDGE

W. F. Taylor; J. Dixon-Scott

In summer-time the beautiful lawns and tree-lined banks, called the Backs, which stretch along the river Cam, are one of the loveliest sights that Cambridge has to offer. Trinity Bridge (upper) connects Trinity College with its gardens. Below is the bridge built in the 19th century between the main building of St. John's College and the extension on the opposite side of the river. It is called the Bridge of Sighs because it bears some slight resemblance to the famous bridge of that name in Venice. Cambridge is one of the two most ancient English universities, the other being Oxford, but the exact date of the foundation of an organized body of scholars there is not known. However, there is evidence of the existence of a number of students in Cambridge early in the 13th century. The first college, Peterhouse, was founded by Hugh de Balsham, the Bishop of Ely, c. 1257, and from the 14th century onwards, new colleges were added including three for women since 1809.

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SOME OF CAMBRIDGE'S RENOWNED COLLEGES

On the left in the picture is the river Cam, crossed by several bridges ; the thoroughfare on the right is King's Parade. Beyond the large lawn, or court, running down to the water, is Clare College, with King's College and its beautiful chapel to its right. Trinity College surrounds the court beyond King's, and behind it and to the left are two parts of St. John's. The architecture of the colleges is of all periods from the Middle Ages to the present. In addition to the men's colleges, there are also three for women—Girton, Newnham, and New Hall.

Annamese invaders, plus internal feuds and revolts, hastened the decay.

In 1863 Cambodia became a French protectorate, being incorporated into the "Federation of Indo-China." It continued as such until 1941, when it was occupied by the Japanese. After Japan's defeat French rule was restored, but in January 1946 Cambodia became "a free state within the French Union." The next development was the French-Cambodian Treaty of 1949, giving Cambodia internal self-government. In 1954 it was recognized by the Geneva Conference on Indo-China as a sovereign and independent state.

Cambodia is a constitutional monarchy under King Norodom Suramarit, who came to the throne on March 2, 1955. Parliament consists of an elected national assembly (91 members) and a nominated council of the realm (24 members). Though Cambodia subscribed to the Colombo Plan, it has consistently followed a policy of absolute neutrality.

Cambridge. Famed as the site of one of England's two ancient universities, this city is the county town of Cambridgeshire, has a population of about 90,000, and is 54 miles by road north-by-east of London. It gets much, though not all, of its living from serving the needs of the 8,000 students and teaching staff of the university. It is also a famous centre of the radio industry and of scientific instrument making.

Added prosperity is brought by tourists who come in thousands every year from all over the world to see the colleges, which form a separate quarter of the city—something looking very different from most towns and cities. You walk most of the time in narrow lanes, in stone passages or under archways, or across little river bridges ; and especially round the wide enclosed spaces of lawn called courts. Surrounding these you find ancient college chapels, old dining-halls, and the sets of rooms used by the students (under-

graduates). Here generations of them have worked, argued, laughed, and spent the happiest years of their lives.

The college buildings are of all periods from the Middle Ages to the present, and there is a good deal of what is called Victorian Gothic. But there is a lot of cheerful Tudor brickwork, especially in St. John's College and Queens', and a feature to notice is the roofs with tiles in three colours, cream, brown and red, mixed together like the threads in tweed.

If you arrive by train, you will find the station a long way from the centre of things. This is because, when the railway was built, the university authorities were powerful enough to insist that this new invention should be kept as far as possible from the seat of learning. And one can be glad that they did so, because shunting and puffing would disturb the peace of the place, especially at night when the chief sound is that of chiming bells.

Most of the colleges lie along or near two ancient streets which come together like the arms of the letter V and then run on as a single thoroughfare to cross the river Cam by the town bridge. In the arms of the V lie the market place and Great St. Mary's, the university church. And at the point of the V is the famous Round Church, older than any of the colleges, for it is Norman work.

Anyone arriving by road from London would arrive in Trumpington Street, in which stands the Fitzwilliam Museum, founded in 1816, housing a fine collection of paintings, prints, pottery, and manuscripts, literary, and musical.

At Bridge Street a Roman road here crossed the river. This bore a Celtic name, Granta (muddy), and was guarded by a fort. When the Saxons came, they called this ruined fort Grantacester, the *chester* or Roman fort on the Granta. But the bridge was the most important thing so the name was gradually changed to Grantebridge. Then the Normans, who built a castle at one end of the bridge and the Round Church at the other, altered the G to a C and left out the "r." And by Chaucer's day the name had become Cambrugge.

The old Roman road and the bridge, bypassing the Fens, attracted trade and caused an important fair to be held here annually. Monks arrived to look after the spiritual needs of the crowd attracted by it, and gradually several religious orders founded monasteries here and students began to come to them for teaching. In 1284 the first college, Peterhouse, was founded. Clare (1326) and Pembroke (1347) came next, close to the Cam, as the river was now being called, and in the next two hundred years the space between market and town wharves along the bank became filled with new foundations. The Cam, navigable to the sea, was useful for bringing building stone from abroad as necessary. The most glorious building of all is the chapel of King's College (see colour plate), built by Henry VI during the Wars of the Roses. It is from here that the famous carol service is broadcast every Christmas. The stretch of river behind the colleges is called The Backs, and for its short length must be one of the loveliest waterways in the world.

The boat-racing course, so crowded in the annual celebration called May Week, is farther downstream, but even here the Cam is too narrow for two boats to race abreast, so the crews row one behind the other in what are called bumping races because they try to overtake and "bump" each other.

The lovely little Tudor building of Sidney Sussex; Christ's College, where Milton and his friend Edward King (Lycidas) were undergraduates; and Emmanuel, are all on the other arm of the V. Downing College, founded in 1800 by the grandson of the man who built Downing Street, Whitehall, lies between the two arms of the letter.

The first two women's colleges, Girton (1869) and Newnham (1871), having been founded so much later, are rather outside the centre of things, and were not officially part of the university until 1948. A third, New Hall, was opened in 1954.

In a long list of famous men associated with Cambridge University, from Cranmer and Oliver Cromwell, through Pitt and Palmerston, to Tennyson and Rupert Brooke, one may especially mention the scientists: Sir Isaac Newton and Lord Kelvin and Sir James Jeans and the atom pioneers of the famous Cavendish Laboratory—Sir J. J. Thomson and Lord Rutherford.

After the Second World War it became evident that care should be taken to control the expansion of Cambridge so that its beauty should not be marred. During 1948-51 a plan was prepared by Sir William Holford and H. Myles Wright. As the 1950s went on, a large part of this was carried out; but there was keen controversy about a relief road, and this matter remained a subject for discussion.

There is also a town called Cambridge in Massachusetts, U.S.A. (many leaders among the early settlers having been graduates of Cambridge University), and this is the seat of Harvard University, the oldest college in the country (founded in 1636), of Radcliffe College for women (1879), and of several theological colleges. Its industries are important, especially the printing of books and the manufacture of soap, glass, ink, and wire cables. Population in 1950 was 120,740.

Cambridgeshire. Much of this fertile English county is fen, but in the south the land rises to the chalk hills connecting the Chilterns, away to the south-west, with the so-called East Anglian "heights."

The northern part forms the Isle of Ely, administered as a separate county. The Ouse and the Nene are the chief rivers of this part, which, until it was drained, formed an immense swamp only a few feet above sea level. Wisbech, a small river-port on the Nene in the extreme north, is the centre of a fruit, vegetable, and flower-growing area. March, with Whitemoor railway marshalling yards just outside, and Ely on the Ouse, famous for its cathedral and its defence by Hereward the Wake against the Normans, are other fenland towns. At Wicken Fen, near Ely, is a 600-acre nature reserve. The county town of Cambridge lies on the edge of the fens, and Newmarket (see article), headquarters of horse-racing in England, is on the chalk. The town is just in Suffolk, although the racecourses are in Cambridgeshire. Grantchester village, made famous in a poem by Rupert Brooke, lies just to the south of Cambridge, while Pampisford, a village much visited for its street of thatched cottages, is a few miles farther in the same direction. The Gog Magog Hills (222 feet) jut out from the chalk ridge to within two miles of Cambridge. Apart from agriculture, fruit and

vegetable preserving and jam-making are important. Malt, beer, baskets, and bricks are also made, and Cambridge manufactures radio and scientific equipment. The area of the county, including the Isle of Ely, is 864 square miles, and the population in 1951 was 255,901. Cambridgeshire is one of the driest of English counties; it also has the doubtful distinction of being the least wooded.

Camel. In appearance the camel is one of the most ungainly of animals. Its neck and legs look too long and sprawling for its body. The feet are split into two padded hoofs almost up to the ankle. Its head is small and ugly, and, as Kipling said, bobs round "like a basketful of snakes." Its brown eyes pop out of its head like marbles, from sockets that seem too small for them. Its nostrils are like slits; it can open them wide, or close them during the sand-storms of its native deserts. Its hair is rough and untidy.

One of the first things you will notice is the queer way in which it chews the cud, its lower jaw swinging from side to side. Its upper lip is cleft up the middle like a hare-lip. The camel reaches for and feels its food with this thick split lip as if it were made up of two fingers.

Drawings of camels have been found in Upper Egypt of the period around 3000 B.C. so the camel has been serving man faithfully for at least 5,000 years, and it was probably the first of all the beasts of burden to be domesticated. Camels made it possible for the Patriarchs of the Old Testament to do their journeys, and it was on camels that the Sahara desert was first crossed. They have great endurance and can withstand heat, hunger, and thirst better than any other beasts of burden. But they show no affection for their owners and they are often savage and ill-tempered, however well cared for.

Dorien Leigh; Gambier Bolton

CAMELS WITH ONE AND TWO HUMPS

The young camel and its mother (top) are of the Arabian species. Note the long legs and padded knees. Below is a specimen of the smaller but rather heavier Bactrian camel of Central Asia, which has two humps.

Besides carrying people or freight, camels can be taught to do certain simple jobs, such as pulling a plough or walking round and round to operate an irrigation pump. They are also taught to kneel for loading, but they do this most unwillingly and awkwardly, even though nature has provided them with tough kneeling pads on the knees and on the arched breast-bone to protect them from the hard, gritty ground. Getting up after being loaded is also a rather complicated movement; then the camel sets off on its fast rolling walk.

The carrying powers of a camel are sometimes exaggerated. On ordinary journeys it can take up to 4 cwt., but for desert crossings it would be given a load of only 2 cwt. A good riding camel can cover 60 miles a day well fed, but baggage camels in thirsty areas achieve much less than that.

If you get seasick easily, you had better not try to ride a camel. It lifts both feet on one side at the same time, tilting its body sideways. Then it lifts the two feet on the other side. The motion is that of a small boat in rough water. Maybe you think that this peculiar rocking movement is why the camel is called the ship of the desert, but

that is not so. It is because it carries people and goods across wide seas of shifting sand.

"Handsome is as handsome does," says the old proverb. If you could see the camel at home, you would forget what an ugly, ungainly beast it is, and only think how wonderfully it is adapted for the work it has to do. No other animal can live and carry great burdens in such a climate, or on such scanty supplies of food and water, but it cannot do this all the time; it must sometimes be able to eat and drink properly and so build up its reserves again.

For food, after a day's travel, a camel may be given a few dates or dry beans, but for its main food it crops the thorny shrubs that grow here and there in the desert. Camels will eat almost anything. They will chew their own leather bridles or tent cloth, and as one writer has said, "a camel can make a breakfast from a newspaper and an old umbrella." The camel's big, solid hump is its reserve of fat, to be drawn upon when food is scarce; and its stomach lining is honeycombed with little cells in which most probably it stores the needed water.

In hot desert regions the camel is the horse, the cow, and the sheep of the herdsmen and traders. It carries all the burdens, it provides flesh and milk for food, and its hair provides material for weaving cloth, one camel yielding between four and six pounds. At night in camp the children of the chief drink cups of camel's thick, cheesy milk, mixed with water. On the chief's table is cooked camel-flesh. The herdsmen wear robes and head-dresses of brown camel-hair cloth. The master sleeps under a camel-hair tent. Even the droppings are collected, dried, and used as fuel.

The mother camel shows affection for its baby. Although the baby camel is three feet high and heavier than a calf when it is born, it is so weak on its legs that it can scarcely walk. Without its mother's milk it would die, but the mother perhaps has to go with the caravan of hundreds of other camels, travelling 25 or more miles a day across burning sand and rocky hills. Then the helpless baby is put into a hammock, and slung from one side of a big baggage camel. The latter may carry a heavy load of other things besides—leather bags of water, bales of cloth and dates, jugs of oil, blocks of rock salt. The baby camel is always carried by a "nurse camel," which walks in front of the mother, who can see and hear the baby and so follows contentedly. After the day's march she feeds the little one, and rubs it with her sensitive lips. It cuddles up to its mother for warmth, for after the heat of the day the nights in the desert are often extremely cold.

There are two kinds of camel, and both are known only as domesticated animals, though there may be a few herds descended from camels that have escaped and gone wild from time to time. The Arabian camel, often called the dromedary (*Camelus dromedarius*), has only a single hump and a rather thin coat; its home is in the hot deserts of Arabia and north-east Africa, but it has been taken to other countries, including the southern United States and northern Australia. The two-humped Bactrian camel (*Camelus bactrianus*) has a darker and thicker coat, and it comes from the deserts of central Asia. Although the two may look quite different, they are very much alike under their fur and humps, and some experts think that they all belong to one species.

CAMELS DRAW THE PLOUGH BESIDE THE NILE

Not only in the desert but also in the cultivated lands of Egypt the camel can be seen at work, for outside the cities and towns it is the most useful of all Egyptian domesticated animals. Here a farmer is ploughing on the banks of the Nile with a pair of camels. Sometimes a team composed of an ox and a camel is used. Though camels have been servants of man for centuries, they exhibit no affection for their masters and seem to be perpetually bad-tempered. They can inflict most dangerous bites. Camel's milk is highly prized by some people.

What SINBAD FOUND OUT *in the* DESERT

The Story of a Young Camel

"I want to go out in the desert," said young Sinbad

SINBAD was a baby camel. He lived with his mother in the far-off land of Arabia, away across the sea. Arabia is very hot and dry. There are deserts there, where the yellow sand stretches away for miles and miles. It was at the edge of one of these deserts that little Sinbad lived.

He was only a few weeks old, but he had already learned to walk on his long thin legs. At first they were so wobbly that he could scarcely stand up on them at all; but now, although they still felt a little queer, he could walk about without once falling down. This made him very proud.

This morning little Sinbad stood in the sand, looking contentedly out across the desert. The hot sun beat down on him, but he did not mind. He liked the sun, and he liked the sand, so he was very happy.

Not far away from him knelt his mother, blinking her eyes sleepily as she chewed her cud. She had a long neck, a small head, and a big body covered with shaggy brown hair. On her back was a great hump. Little Sinbad thought she was a wonderful creature.

"Mother," he said to her, "shall I ever be as big as you are?"

"Of course you will," she told him. "You are a fine young camel and you are growing very fast."

"I'm glad," he said happily. "I want to be big, for then I can walk out there on the sand that stretches away so far, and I will see what the desert is like."

The mother camel looked at him for a moment, working her lower jaw from side to side as she chewed. "Yes," she said, "I suppose you will want to get out in the desert as soon as you are old enough. But you will not find much out there to see. In the desert there is nothing green—only sand and rocks and a few prickly shrubs."

"But I want to see it, anyhow," Sinbad said. "I want to go out in the desert."

"You will," his mother said. "You will cross the desert many times when you are older, and carry loads on your back for our master. Sometimes our master himself will ride on your back. There he comes now," she added. "He is bringing me my breakfast."

Sinbad saw a man come out of a tent, carrying an armful of fodder. He was a tall man with a brown skin. Instead of a hat, he wore a bright red and white striped turban wound about his head.

The little camel moved nearer to his mother. "Our master brings you your breakfast every morning, doesn't he?" he asked. "He is a kind master."

"Yes," answered his mother, "he is kind, but he only feeds me so that I will be strong enough to work for him. Our master could not get along without his camels to carry burdens for him across the desert. There is no other creature that can travel in the desert the way we can. We have soft pads on the bottoms

of our feet that spread out wide and flat when we walk and keep our feet from sinking in the deep sand. We can go without food and water, too, if we have to. And we often *do* have to, out there in the desert where no green thing grows, and where there are no pools or streams of water."

"But what do you do when you get hungry and thirsty, mother?" little Sinbad asked.

"We are well fed and watered before we start on a journey," his mother told him, "so we do not get hungry or thirsty very soon. We can live for a while on the fat in our big humps, and we can store enough water in our stomachs to last us for days and days."

"We are wonderful creatures, aren't we?" little Sinbad said.

"We are very wonderful creatures," his mother answered. "You should be proud that you are a camel."

She got slowly up, lifting herself first on her hind feet and then on her front feet, as camels always do. Now little Sinbad could see the big leathery pads that grew on his mother's knees and chest. He would have pads like that, too, he knew, when he was a little older. All camels have them so that they can rest softly when they kneel on the ground.

He stood beside his mother while she ate her breakfast. When she had finished, her master made her kneel down and put a strange looking saddle across her back. At once she began to groan so loudly, as if in pain, that little Sinbad was frightened.

"No--o—o———o—o—o!" she groaned. "No—o--o———o—o—o!"

"Does the saddle hurt you badly, mother?" Sinbad asked anxiously.

"No," she answered, "it does not hurt at all, but I groan just the same. You must always groan when our master puts anything on your back. No matter whether it is light or heavy, you must groan as loudly as you can."

"What for?" little Sinbad asked in surprise.

"It is the way we camels do," she answered. "Perhaps if we did not, our masters would put loads on our backs that were too heavy to carry—I do not know. But I *do* know that we always groan. You must remember this when you are old enough to travel."

"I will," little Sinbad promised. "I will groan with all my might. But, mother, why has our master put that big saddle on your back? Do you know why?"

"I suppose we are going to make a journey," his mother told him. "A journey out into the desert."

"Oh!" cried little Sinbad happily. "Then I will walk far out on the sand, as I have always wanted to!"

"No, Sinbad," she answered. "You are too young to walk far. You will have to be carried. Baby camels always have to be carried when they make a long journey."

She was about to say something more, but just then their master led up one of his biggest camels and made it kneel down. Across his back he put a saddle and on each side of this he fastened a heavy load.

When he had finished doing this, he picked little Sinbad up in his arms and put him into a sort of hammock that swung from one side of the big camel's saddle.

Sinbad was surprised and frightened. He kicked and squirmed as hard as he could, but his mother called to him and tried to quiet him.

"Be still, Sinbad!" she said. "They are not going to hurt you. You will ride in your hammock and I will walk just behind you. All baby camels ride like that."

"But I'd rather ride on *your* back, mother," little Sinbad cried. "Why can't I?"

"Because I must have you where I can see you all the time," she told him. "Be still now, and you will be all right."

So Sinbad lay still in his hammock while their master fastened a great load on his mother's back. "Maybe this will be fun after all," he thought, now that he knew his mother would be close to him. "I shall see the desert that I have wondered so much about."

"*Goom!*" their master cried suddenly.

"*Goom!*" This was his way of saying to his animals, "Get up!"

Sinbad's mother and the big camel got slowly to their feet, groaning and grumbling. The hammock in which little Sinbad lay began to toss and sway, for a camel has a very queer way of walking. It moves on two feet on one side of its body at the same time and then the two feet on the other side of its body at the same time, so that its body rolls from side to side. But little Sinbad did not mind this; indeed, he liked the motion.

Soon they came to where there were a great many other camels with loads upon their backs. They were being formed in a long line, one camel behind another. Sinbad's big camel took his place in the line, and Sinbad's mother followed close behind.

It was all very new and strange and exciting. It was exciting to see the desert, like a great ocean of sand all round him, and to watch his mother plodding patiently along behind him, holding her head high and looking at him all the time with her big soft eyes. And it was exciting to hear the tinkling of the little silver bells that many of the camels wore.

For a long time they travelled on under the hot sun. When noon came, the caravan stopped for a rest. Sinbad's master lifted him down from his hammock. The little camel ran quickly to his mother and greedily drank the milk that he was so hungry for.

When he had finished, he walked about for a while. It was wonderful, he thought, to be out in the desert like this! He would have liked to walk on and on, but his mother was kneeling down, half dozing, and he did not dare to get far away from her.

The other camels were kneeling, too, resting quietly until the time came to start on again. Most of them had crossed the desert many times before, and such a journey as this was nothing new to them. But to little Sinbad it was all very strange and exciting.

He looked curiously at the camel drivers sitting about on the sand and talking to each other. When would they be ready to go on across the desert? he wondered.

Suddenly he saw some of them spring to their feet. Then others jumped up, and still others, until all of them were running about, calling excitedly to one another. The camels were

The hammock in which little Sinbad lay began to toss and sway

excited, too, and the men were very careful not to get too close to them. For no one can tell when a camel may lose its temper and begin to kick and bite anyone who happens to be near it.

Little Sinbad raised his head and listened. He heard a low roaring sound that rolled across the desert, growing louder every minute. " The wind ! The wind ! " he heard an old camel say. " The wind is coming ! "

Sinbad had heard the wind blow before, but he had never heard it roar like this. He ran as fast as he could to his mother's side. " What is it ? " he cried. " What is it, mother ? "

" A sand storm is coming," she told him. " You must lie down here beside me, Sinbad. Stretch your head flat on the ground ! See how the other camels are doing ! "

Little Sinbad at once did as he was told, for something in his mother's voice frightened him. " What is a sand storm, mother ? Will it hurt me ? " he asked.

" Not if you do as I tell you," she answered. " You must close your eyes. Your long eyelashes will help keep the sand out of them. And you must close your nostrils tight so that the sand will not get into your nose. Then you must lie as still as you can lie."

The hot wind came with a mighty rush and roar, and the sand beat against Sinbad's body like sharp little needles. He closed his eyes and he closed his nostrils as tight as he could ; and he waited.

The camel drivers huddled behind the kneeling camels for protection. The camels lay very still, their heads flat on the ground, their eyes and nostrils closed, while great clouds of sand came sweeping in across the desert.

It seemed a very long time to little Sinbad that he lay there, trembling with fright. After a while the storm died down and the wind stopped roaring. Then in the silence he heard his mother's voice again.

" The storm is over, Sinbad," she told him. " You can open your eyes now. You have been brave."

" Have I, mother ? "

" Yes," his mother said. " Not many little camels as young as you are have gone through a sand storm like this. You did everything exactly right."

" The camel drivers had to hide behind their camels to get away from the storm, didn't they, mother ? " little Sinbad said.

" Yes," his mother answered, touching him with her queer soft upper lip ; " but we camels didn't have to hide. It is better to be a camel than anything else when a sand storm comes. We camels belong to the desert and it belongs to us. You have good reason to be proud, little Sinbad ! "

The little camel thought about this for a long time. He was still thinking about it when the camels moved off again on their journey. High up in his little hammock, he looked across the desert that stretched on and on as far as he could see. He was happier than he had ever been before.

As the camels swayed along on their way, little Sinbad thought : " I am glad that I am a camel. I am glad that I belong to the desert. I would rather be a camel than anything else in the world ! "

It seemed a long time to little Sinbad that he lay there, trembling with fright

Camellia. In India, Japan, and China the evergreen shrubs of different kinds of camellia grow wild. One of them, the tea plant, *Camellia sinensis*, has been cultivated for centuries. The beautiful *Camellia japonica* was brought to England from Japan in 1738 and is a favourite greenhouse plant. The leaves are tough, shiny, and dark green, a good background for the flowers, which are like small waxy, scentless roses, white, yellow, pink, or red (but flatter in shape than roses), and have become "double" through long cultivation. The wild variety has deep pink single flowers. The seeds of some camellias contain oil very similar to olive oil. The name of the shrub comes from Camellus, the Latinised form of the surname of Georg Josef Kamel, a 17th-century Moravian Jesuit who found specimens in Asia.

CAMEO MASTERPIECE

Here is a very old and beautiful cameo, the work of an ancient Greek carver. It shows Alexander the Great with his mother Olympias. The detail of the carving on helmet and armour is superb in craftsmanship.

Cameo. An engraved gem or sea-shell bearing a design cut in relief is called a cameo, as distinguished from an intaglio (pron. intal'yō), in which the engraved object is hollowed below the surface. Cameos are most frequently made from gems composed of two or more layers of different colours. The figures are cut in relief upon one of the upper layers of colour, and the under layers form the background. The stones most used are agate, onyx, sardonyx, and chalcedony. Cameos have been used both as personal jewelry and for adorning cups, vases, and even furniture.

The art of cameo-cutting dates back to the 6th century B.C., but cameos were not made in large numbers for another two hundred years. The art was at its height in the 1st century A.D., from which age a great number of examples, as well as earlier ones, are preserved in museums. The industry degenerated with the end of the Roman Empire and there was no real revival until the Renaissance, when shells were used as well as gems. But after the end of the 18th century few further cameos were made, as forgery was easy, and the art fell into disrepute. It is little practised to-day.

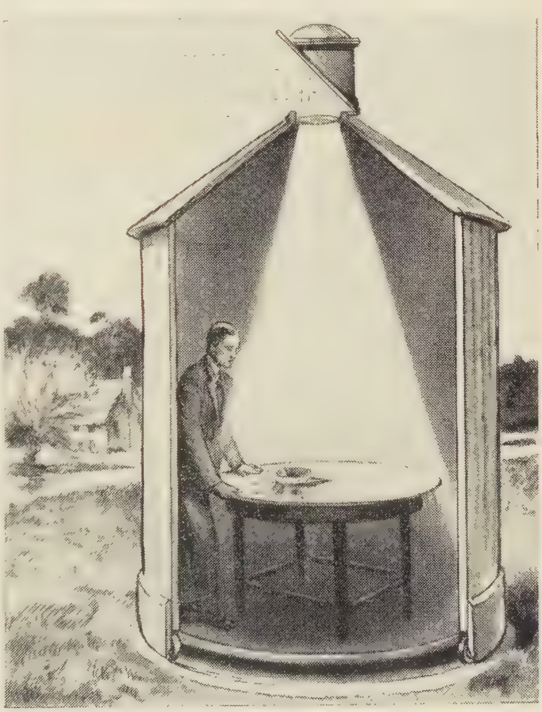
Camera Obscura. If a room is darkened on a bright day, leaving only a small hole in the window shutter, an upside-down picture of the scene in front of the hole will be reflected in a mirror placed near the window. This is the simplest form of the camera obscura, which is Latin for "dark room"; it was used several centuries ago for observing eclipses. A smaller camera obscura can be made by constructing a small box with a pin-hole in one side.

A lens put in the opening will give a much sharper image. If this image is allowed to fall on a plate or film covered with chemicals easily affected by the action of light, and the plate or film is developed and treated by other chemicals, a permanent picture is obtained, and the camera obscura becomes a photographic camera. (*See* PHOTOGRAPHY.)

If a mirror is put at an angle of 45 degrees inside a camera obscura, an image of the objects before the lens will be formed, right side up, on a piece of ground glass put above the mirror. The view-finder, with which photographic cameras are provided, is just a very tiny camera obscura of this sort. The instrument known as the periscope (see article), so important in submarine warfare, is a camera obscura arranged to reflect downwards.

The camera lucida, a simple reflecting device, when placed before the eye projects an image of the subject on drawing-paper, where it can be copied accurately. Formerly much used in microscopic work, it has been supplanted by modern photographic methods. It is still used, however, by draughtsmen.

Cameroons. At one time the German colony of Kamerun, this large district on the coast of West Africa, facing the Gulf of Guinea, was divided between Great Britain and France after the First World War. The British Cameroons



A CAMERA OBSCURA

In a camera obscura (Latin for dark room) the reflection of objects outside is cast by the mirror on to a white table in a darkened room. The camera obscura, first used in Italy in 1568, is little more than a simple periscope.

CAMEROONS : A WOOD-CARVER OF DUALA

The inhabitants of the Duala district in the French Cameroons are skilled wood-carvers, as examples of this man's handiwork testify. Duala, the chief port of the territory, stands on the Cameroons river and exports palm oil, cocoa, and rubber. The French Cameroons has a population of 3,142,000, mostly Negroes.

consists of a narrow belt extending north-east along the whole length of the Nigerian boundary, except for a short break, from the Atlantic coast to Lake Chad in French Equatorial Africa. The territory has an area of 34,081 square miles, and in 1953 had an estimated population of about 1,430,000, mostly Bantu and Sudanese Negroes.

The whole of the rest of the Cameroons is French, and has an area of 166,489 square miles, with a population in 1955 of 3,142,000. Both the British and the French Cameroons are administered under United Nations trusteeship. In the British sphere is the port of Victoria, on Ambas Bay, facing the Atlantic, and in the French the port of Duala, on the Cameroons river estuary. In the French Cameroons there are nearly 4,000 miles of roads and 314 miles of railway. The British Cameroons is administered by the government of Nigeria, but the French Cameroons forms a self-governing territory, the seat of government being at Yaoundé. The population of this town in 1955 was about 38,000. Other large towns are Buea on the slopes of Cameroons in British territory, and Ngaoundéré in the north of the French part.

The most prominent physical feature of the Cameroons is Mount Cameroon (13,350 ft.). The country is close to the equator, so the vegetation and climate are tropical. The chief rivers are the Sanaga, Mbam, Nyong, Sanga, Logone-Shari, and Dscha. The Negroes here are mostly Bantus, superior to many of their African neighbours. There are enormous forests, ebony being one of the native woods. Palm oil and palm kernels, cocoa, rubber, and ivory are exported.

The Portuguese, who explored this coast in the 15th century, gave the north-east corner of the Gulf of Guinea the name Camaroes (meaning prawns—which swarmed in the shallow coastal waters). This part of West Africa was once one of the darkest regions of Darkest Africa, in almost every human sense. From the 16th century until the 19th century the Gulf of Guinea was the headquarters of the slave trade. It was from this region that shiploads of human beings were sold into slavery in America and the West Indies.

Little of the interior was explored until the middle of the 19th century, when German and British settlers began to develop the country. In 1884 Germany declared a protectorate over the Cameroons. In 1911, following much disputing, further large areas were ceded to Germany by France. These gave the Cameroons outlets on to the Ubangi and Congo rivers. In the early days of the First World War (1914–18) the colony was invaded by British and French forces, and by February 1916 it was completely in the hands of the Allies. In 1919 the administration of the Cameroons was divided between Great Britain and France.

During the Second World War (1939–45) the French Cameroons declared full loyalty to General de Gaulle on August 29, 1940, and between then and March 1942 strategic roads were built which linked Duala with Khartum in the Anglo-Egyptian Sudan. These roads enabled the Allies to send supplies and reinforcements to Egypt and the Middle East without using the long and dangerous route round the Cape of Good Hope.

Camomile (often spelt Chamomile). Among the many plants used as herbal medicines, the true camomile, wild or cultivated, was used chiefly as "tea" brewed from the flowers, to make patients perspire. Sometimes the root was chewed as a tonic, and the flowers are still used in some shampoos for fair hair. The plant belongs to the daisy family (*Compositae*), and its scientific name is *Anthemis nobilis*. It has rather feathery leaves and white flower-heads with yellow centres. The whole plant has an aromatic scent. It grows wild in many sandy and gravelly places in England, especially in the south. A related plant known as wild camomile (*Matricaria chamomilla*) has the leaves still more finely divided and the yellow centres of the flower-heads, instead of being flat, are tall and cone-shaped.

Camouflage. Most people think of camouflage as the war-time disguising of guns, ships, fortifications, vehicles, aircraft, or buildings, so that they will not be seen by an enemy, particularly by an enemy aeroplane. But long before men were clever enough to hide their military activities under netting, paint, canvas, or the carefully arranged branches of trees, animals were deceiving, and being deceived by, their stronger foes and weaker prey. (*See* Protective Coloration.)

Camouflage is a French word meaning disguise, and most animals practise it in one way or another, either to catch other animals for food or to save themselves from being caught by other animals. There are many creatures which can effect the most surprising changes of colour within a few

seconds; as, for example, many fishes, frogs, toads and lizards, of which the chameleon (see article) is the best known.

The plumage of birds like herons and partridges is another form of camouflage. The heron's blue-white breast merges perfectly with the sky when it is flying and seen from below. Walking across a stubble field, one is sometimes brought to a standstill by a whirring noise, and in a moment a covey of partridges has risen and flown away; yet a second before not a bird was to be seen, so well did the colours of their plumage blend with the field.

It is not surprising, therefore, that the man who evolved the elaborate military camouflage developed in the First and Second World Wars should have been Abbott Thayer (1849–1921), an artist who had spent his whole life studying the colour schemes of animals, birds, and insects. In the British army a special section of the Royal Engineers became responsible for camouflage. It consisted mostly of artists, architects, scene-painters, and zoologists. Ships were painted in zigzag lines of various colours, so that when they were moving at speed it was difficult to detect their real outline. Coverings of netting, strips of cloth, and branches of trees were used to hide artillery, tanks, vehicles, stores, and even infantry. (The use of tree branches to disguise soldiers was not altogether a new idea, as anybody who has seen or read Shakespeare's *Macbeth* will remember.)

CAMOUFLAGED SNIPER

Snipers must see without being seen, and this man is invisible from a distance. He wears dark netting over his face and hands, because otherwise the light skin would betray him to hostile observers.

The camouflage of the First World War succeeded quite well in deceiving human eyes and ordinary cameras, and was also used successfully at times in the Second World War. But eventually photographic filters revealed that type of camouflage by picking out artificially-coloured objects from their natural setting. So it became necessary to think out more elaborate methods, such as roofing roads to look like fields, or hiding the flat roofs of munition factories under earth on which actual buildings were built.

In other places dummy airfields would be built so that the enemy was deceived into bombing them instead of real aerodromes. But the dummy buildings had to be put up properly; it was useless merely to lay outlines of them on the ground as the Germans sometimes did. One such mock aerodrome built by the Germans in the Second World War was photographed by R.A.F. pilots and the photographs were then examined through a stereoscope. This showed the buildings to be quite flat, and proved that they were only painted outlines in wood. So the next day a British

BRITISH CRUISER IN HER COAT OF CAMOUFLAGE

The art of camouflage is to make an object hard to pick out from its surroundings, and the outline of this cruiser *Frobisher* has been broken up by camouflage painting, making her not easily recognizable when seen at a distance. This type of camouflage was used in the Second World War for vessels in northern waters. Submarine commanders viewing a camouflaged vessel through a periscope had difficulty in determining its type and the range.

CAMPERS READY FOR THE WATER

Equipped with fishing-tackle and a light sailing-boat, this family is prepared to make the most of its camping holiday. The awning forms a sort of veranda outside the living quarters, and, besides serving as a dining-room and also a playground in wet weather, permits such domestic tasks as washing-up to be done under cover.

aeroplane dropped a wooden bomb on it! But many German camouflage schemes were very good.

The familiar smoke-screen, used by warships or released over towns to hide them from enemy aircraft, has been used for millions of years by squids and cuttlefish which, when alarmed, belch forth a dark brown or purple dye to cloud the water for many yards around them.

Camphor. In the moist, sub-tropical climate of Formosa flourish forests of the camphor laurel tree. From this tree, which is also found in Japan, China, and South Vietnam, comes the thin waxy substance, camphor, highly prized for centuries for its medicinal properties. The camphor is extracted by a process which has varied little over the years. Chips of the wood, leaves, and bark are enclosed in earthenware vessels, and steam is passed in. The camphor rises to the top of the pots and condenses into small white crystals called gum camphor.

Carefully refined, these crystals are used in various remedies. Dissolved in olive oil, they form camphorated oil, the old-fashioned remedy used for rubbing on the chests of children who have coughs. Several liniments for pains and sprains contain camphor, and compound tincture of camphor is more familiar as another cough cure, paregoric. It was once used to keep clothes moths from drawers, but for this purpose has been replaced by naphthalene.

The chief use of camphor nowadays is in the manufacture of celluloid (in which it is mixed with cellulose nitrate) and other plastics. Here, however, it is more usual to replace natural camphor by a synthetic form made from turpentine.

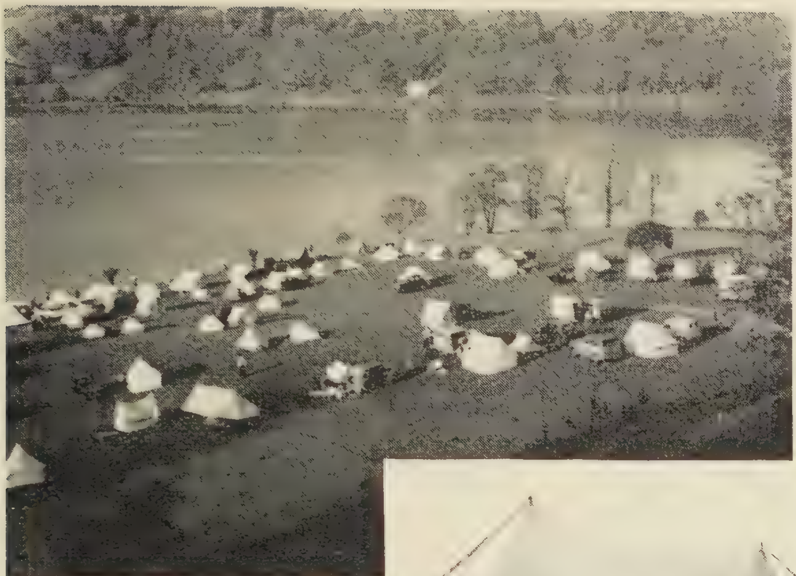
Camping. There are many versions of outdoor camps, from the child's dust-sheet tent in the garden to the sophisticated chalet of the "holiday camp," but all those who camp have the same basic idea in their minds, the idea of escape from bricks and mortar and dull routine to the enjoyment of fresh air.

In countries like New Zealand, Canada, and the U.S.A., camping often involves long journeys in lonely country, demanding skill in woodcraft and pathfinding, and the ability to shoot quickly and straight.

In such comparatively crowded lands as Great Britain and the countries of western Europe, where there is no great danger from animals and where one is never very far from a village or town, "camping out" has become ever more popular in the 20th century. The overcrowding of industrial cities has helped it forward. So, too, has the popularity of the bicycle. Many people long for solitude and quiet, and fancy the idea of cooking their own food over a camp fire, carrying fresh water from the streams, and going to bed by candlelight with only a sheet of canvas between them and the stars. Others prefer "mass camping." The first holiday camp in Great Britain was opened in 1902, and "mass camping" has so developed that many family holiday camps now resemble little self-contained towns, with their own shops, restaurants, ballrooms, swimming-pools, tennis-courts, cinemas, water supply, and electricity.

But this is not what Scouts, Guides, or members of Cadet Corps mean by camping. They, and thousands of others old and young, with the spirit to venture forth to live for a time on closer terms with the beauties of the highways, byways, fields, woods, and rivers of the countryside, derive infinitely more pleasure from the kind of camping that means relying on one's own resources. To live the simple life in the open air, in close contact with nature in either her smiling or her more sullen moods (for the true camper defies the weather, and in Britain he usually gets all there is of every kind and learns to enjoy it all); to be free to move from place to place as one pleases and, within reasonable limits, to do as one pleases—these are the delights of true camping.

Some go alone, on foot, awheel, or by canoe. Others prefer the company of a well-chosen friend, or perhaps a small group of friends. However you choose to travel, the golden rule is to *travel as light as possible,* that is, to take with you as little as you can. There is a very definite limit to the amount that one person or one bicycle or one canoe can conveniently carry. If you arrive at your night's camping ground too exhausted with the ardours of getting there, you will enjoy your camping so much the less.



This picture, taken in connexion with a camping-site contest, shows tents in wide variety of shape and size by the lakeside at Grasmere.

Courtesy of the Camping Club of Great Britain and Ireland

(Above.) Youngsters can, and often do, "play camping" with little home-made tents like this. Space—small; weather resistance—not much.

(Left.) Here is the real thing. These ten-year-olds have a roomy tent and a fine stove in the Bracken Deen section of the Cuffley School camp.

As for the site, pitch your tent on a dry, sheltered spot, with its opening facing away from the wind—but not under trees because of damp and the hazards of lightning or a falling branch. Nevertheless, trees should be conveniently near, to provide sticks for your fire. Of course, you can use a pressure stove if you prefer it, but that is just one more thing to pack, and by the time you have packed essentials such as ground-sheet, sleeping-bag, cooking utensils, canvas bucket, torch, food, toilet articles, and extra clothing, you will probably feel that this is weight enough.

Cooking can be done on a couple of bricks set in the midst of the fire or in a pot suspended from a tripod. Potatoes can be roasted in the embers. Fish can be caught, and fried. A quick and filling dish consists of bread dipped in milk and sprinkled with cheese, fried, and served with an egg on top.

There are, of course, the more organized and supervised camps, such as those for Cadets, Scouts, Guides, and so on, as well as the many school holiday camps—and what grand opportunities these offer for making new friends! The success of such camps depends on the readiness of each member of the party to contribute his full share of the work, as appointed by the camp leader; and many useful lessons in co-operation can thus be learned pleasantly enough, as well as a high standard of camping technique and general behaviour that will stand the camper in good stead when he sets out on his own.

The importance of good manners cannot be too strongly emphasised, especially in such matters as securing permission to occupy a site, keeping it tidy when you get it, keeping the camp fire within bounds, digging latrines and rubbish pits and filling them in before you leave, closing all field gates, and generally showing thoughtful respect for all those people to whom the countryside is their permanent home and their means of livelihood.

The challenge of meeting every situation (and every kind of weather) with cheerfulness and fortitude, the overcoming of difficulties by your own resourcefulness—these develop qualities that can be put to good use in facing the ups and downs of everyday life.

Campion. The best-known wild members of the pink family, *Caryophyllaceae*, are the campions. They all have stems with swollen joints, leaves and side shoots in pairs, and flowers with five petals so deeply divided that they appear to be ten. In May and June the white campion (*Lychnis alba*) is in flower in fields and hedges, and is sweetly scented in the evening, when both scent and whiteness attract the long-tongued moths to sip the nectar at the bottom of the flower tube.

The red campion (*Lychnis dioica*) grows in shady hedges and woods, often flowering with bluebells. Both red and white varieties have a hairy, vase-shaped calyx, which has dark red ridges in the red campion. Both have male flowers (with stamens) on one plant and female flowers (with pistils) on a separate plant.

Bladder campion (*Silene cucubalus*) grows in fields and waste places. Its stems and leaves are a waxy greyish green, the flowers white, some complete, others lacking stamens or pistil, and the calyx is like a bladder. The closely related sea campion trails its stems on shingly beaches. A charming campion of wet meadows and ditches is the pink-flowered ragged robin, which is like a red campion with its petals each divided into four instead of two. The moss campion forms red-flowered cushions on mountain sides.

BEAUTIFULLY SITED CAMP IN THE LAKE DISTRICT

The Lake District is very popular with campers, despite the heavy rainfall, and this site near Rydal Water, Westmorland, is set amid some of the finest scenery in the British Isles. Motorists with trailer caravans can camp in luxury, compared with tent-dwellers. Many caravans have a kitchen, lighting, and sanitation, besides a living-room and very comfortable sleeping accommodation. Farmers usually allow caravans on their land on payment of a small fee.

GREAT NATION *of the* NEW WORLD

Canada. Second largest country in the world, and a young people's country!—that is Canada. If you tilt a globe so as to look down on the North Pole, you will see how important a position, in the centre of things, Canada plays in this air-and-atom age. Above is the vast curve of Asia and Europe almost surrounding the Arctic and North Atlantic. Below is the territory of North and South America. From Edmonton, Alberta, it is just under 5,200 miles to Amsterdam and just over that distance to Tokyo.

From the political and military point of view, in a world of straight-line air travel, Canada lies directly between the two most powerful of all nations, the U.S.A. and the U.S.S.R.

Her special interest for British people lies in the fact that she is a member of the British Commonwealth of Nations, a member whose influence in world affairs and whose voice in world councils are growing more powerful all the time. Of her mixed population, about 46 per cent. are of British descent. Her system of law is founded on that of Britain; she has a House of Commons; she acknowledges the same Sovereign, looks back to a common history, and still sometimes speaks of the British island as "back home."

Her special difference lies in the fact that while her territory is more than thirty times as great, her population is less than a third that of Great Britain.

This territory contains great riches. The minerals in the rocks, the vast crops of wheat on her prairies, the timber of her enormous forests, the water power of her strongly rushing rivers, make Canada a wealthy country. But all her resources could be much more developed than they are now, because Canada needs *people*!

We speak of her as a young people's country, and she is indeed a land of great opportunity for the ambitious boy or girl because everything is expanding—her wealth, her business, and her towns and cities. There is plenty of room. But she is a young people's country in another way too. A very high proportion of her children are under ten years of age, with all their youthful, vigorous, working age before them. This is because higher wages and salaries and greater opportunities allow most Canadians to have larger families than people in Britain.

In Britain if you climb a hill it is difficult to find a view which does not show the hand of man. The old great forests have been cut down centuries ago, and the marshes drained. Everywhere you see houses, factories, or the steel towers of electricity lines. In Canada big towns and cities with great concrete buildings and big department stores have wild country within an hour's car ride or closer. And people who take for granted that they must all have what would be regarded as luxuries in most countries, can still find the tracks of wolf or bear in the snow or make a forced landing in an aircraft and be 500 miles from the nearest help. Such conditions, and the way they are used to facing them, have made Canadians vigorous, ambitious, and optimistic.

The sheer size of their country—over 3,800,000 square miles—is difficult for British people to grasp. It is a huge, tilted rectangle of territory, nearly as large as Europe and much eaten into by the sea. Hudson Bay and its southern extension of James Bay looks, on the map, as though it were a vast wedge splitting Quebec and Ontario wide apart.

The south-east base of the rectangle runs from Lake Erie to the Gulf of St. Lawrence and Newfoundland, including the peninsula of Nova Scotia. The north-eastern side runs up to form the coast of Baffin Bay, opposite Greenland, ending at the tip of mighty Ellesmere Island only 475 miles from the North Pole. The north-west side consists of a vast archipelago along the Beaufort Sea, the frontier with the U.S. 49th state, Alaska, and the coast of British Columbia. The southern side is the famous 49th parallel of latitude, the unfortified boundary with U.S.A., and towards the east the northern shores of the Great Lakes.

Most of this territory lies south of the Arctic Circle, but the winters are long and hard, with much of the land under snow for about eight months of the year, followed by a trying period of melting slush. Consequently people have mostly settled as far south as possible, and to-day four-fifths of the population live within 150 miles of the U.S. frontier. In fact nearly a quarter of them live in the extreme south-eastern tip of our rectangle. This is Canada's "farthest south," lying in about the same

Extent.—Area over 3,800,000 square miles. Most northerly point Cape Columbia, about 475 miles from the Pole. Population (1955 census) 16,000,000.

Rivers and Lakes.—St. Lawrence, Ottawa, Nelson, Churchill, Red, Saskatchewan, Athabaska, Peace, Mackenzie, Slave, Yukon, and Fraser Rivers. Largest lakes (excluding the Great Lakes, which form part of the southern boundary). Great Bear, Great Slave, Winnipeg, Athabaska, Reindeer, Winnipegosis, Manitoba, Nipigon, Lake of the Woods.

Mountains.—Coast Range, Rocky Mountains, Selkirk Mountains, Gold Range, Caribou Mountains, all on Pacific coast. Highest: Mt. Logan (19,539 feet), in Saint Elias Range.

Chief Products.—Wheat, oats, barley, hay, flax, potatoes, turnips, orchard fruits, livestock and dairy products; lumber, pulpwood, and other forest products; textiles, agricultural implements, iron and steel, leather, shoes; salmon, cod, halibut, haddock; coal, oil, gold, nickel, lead, copper, silver, cobalt, zinc, uranium, asbestos; furs.

Provinces.—*Maritime*: Newfoundland, Nova Scotia, New Brunswick, Prince Edward Island. *Eastern*: Quebec, Ontario. *Western*: Manitoba, Saskatchewan, Alberta, British Columbia. *Territories*: Yukon Territory, Northwest Territories.

Chief Cities (1956 census).—Montreal 1,109,439; Toronto 667,706; Vancouver 365,844; Winnipeg 255,093; Hamilton 239,625; Edmonton 226,002; Ottawa 222,129; Calgary 181,780; Quebec 170,703; Windsor 121,980; London 101,693; Halifax 93,301; Regina 89,755; Verdun 78,262; Saskatoon 72,585; Kitchener 59,962; Sherbrooke 58,668; St. John's (Newfoundland) 57,078; Victoria 54,584; Saint John 52,491; Brantford 51,869; Three Rivers 50,483; Oshawa 50,412.

ARMED SHEPHERD OF WESTERN CANADA

Though cattle are usually associated with the prairie provinces of western Canada, the cowboy has to share the ranges with the shepherd. Sheep-farming is not confined to the west, as the provinces of Quebec and Ontario vie with Manitoba, Alberta, and Saskatchewan in importance in the industry. The shepherd, who may live alone in his camp for several months, is armed to enable him to protect his flock against coyotes and wolves, and to shoot game for food.

latitudes as New York and Boston, and it consists of a tongue of fertile, rolling farm country with a long coastline on Lake Huron to the north and another long coast along Lakes Erie and Ontario on the south. The most southerly city in Canada is Windsor, Ontario, with the great American city of Detroit just across the river frontier.

Of Canada's natural resources, the first to be mentioned must be the timber from her enormous forests. So important is the wealth from these trees that one Canadian in every eleven is dependent upon them, directly or indirectly, for employment. Over 80 per cent. of these forests consists of cone-bearing trees such as jackpine, lodgepole pine, balsam fir, alpine fir, and tamarack. But most important of all is the spruce, familiar as the Christmas tree. This type of forest stretches in a great belt from the Atlantic to the Rocky Mountains and northwards to Alaska.

Not all this vast wood wealth is at present available for use. Much of it lies too far from the markets where it must be sold, or in areas where there are no means of transport. Accessible supplies of timber, large as they are, are not inexhaustible, and young trees must be cultivated and planted to replace those cut down.

In the pioneering days trees were used simply to provide timber products—for building houses and making furniture ; for constructing wagons or bridges or ships. But nowadays by far the most important use of wood is for the making of pulp. And from this pulp comes a truly astonishing list of goods, from cardboard to chemicals, from explosives to photographic films.

Pulp can either be ground up with water in great rollers into a sort of porridge which then dries in sheets (mechanical pulp) ; or digested in baths of chemicals (sulphite pulp). This provides sundry resins and oils, rayon, cellulose wrapping, industrial alcohol, artificial leather, surgical dressings, gramophone records, and many other products. From the mechanical pulp comes the newsprint, or huge rolls of paper, on which newspapers, books, and publications of all sorts are printed. The page you now touch comes from newsprint made from trees which once grew in Newfoundland.

Canada has about 150 different species of trees but not more than about 30 of these are important to commerce. They include some 20 which are cone-bearing, like the spruce or the great Douglas fir of British Columbia, and are known commercially as softwoods : and a dozen or so of the hardwoods, such as maple—the national emblem tree—and oak. Pulpwoods come chiefly from Quebec, Ontario, New Brunswick, Newfoundland, and Manitoba. Logs for planks and general

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CONTRASTS IN CANADA'S VAST OUTDOORS

Canadian Pacific Rly.

In the foothills of the Rocky Mountains, the long transcontinental train winds its way along the shores of Lake Louise, with dense forests of conifers stretching away in the distance to the flanks of the mountains. The leading coach of the train is an observation car, from which passengers can enjoy views of heights, forests, and lakes.

Magnificently mounted, the corporal of the Royal Canadian Mounted Police makes an imposing figure as he stops to chat with a shepherd on the rolling prairie of Saskatchewan. Canada's celebrated police force maintains law and order throughout most of the country, only Ontario and Quebec maintaining their own provincial police forces. There are more motor vehicles than horses in the force, and there is also a marine division, which operates corvettes and other seagoing craft. The brilliant scarlet tunics are worn only on special occasions.

The fine parliament house in Ottawa, the capital of Canada, replaced a building burnt down in 1916. A prominent feature of the new structure is the Tower of Peace, in which is a memorial chamber, commemorating the 60,000 Canadian soldiers who were killed during the First World War. Canada is a self-governing state, of which the British sovereign is the titular head. The powers of government are divided between the federal, provincial, and municipal legislative bodies.

Canadians are great lovers of the out-of-doors, and north of the St. Lawrence River and the Great Lakes, there are thousands of square miles of wooded hill-and-lake countryside abounding in game, and criss-crossed by rivers teeming with fish. The two anglers in the photograph are trying their luck in one of the side streams of the Gatineau, which itself is a tributary of the Ottawa River.

Upper, Canadian Pacific Rly

Banff National Park (upper photograph), in the province of Alberta, covers 2,585 square miles, and is a favourite holiday resort of western Canada. Situated in the foothill country of the Rocky Mountains, it is noted for the massive grandeur of its scenery. The purpose of Canada's national parks is to preserve places of outstanding beauty and interest, and to protect wild animals and birds.

The leaf of the sugar maple is Canada's national emblem, and the tree is the source of maple syrup and sugar. As soon as the sweet sap begins to rise in the trunk after the winter rest, the tapping is done. A small hole is drilled in the bole, and from it the sap drips into a bucket (right). Each mature tree gives some 10 gallons of sap, which when boiled down, yields about a quart of darkish-brown syrup.

With the fall, or autumn, come the first cold breaths of winter to change the varied greens of summer to wonderful splashes of gold, russet, and red. Only the conifers retain their somewhat sombre greens. The woods on the banks of the Gatineau River, in the province of Quebec, have received the first touch of autumn's brush, and have entranced the paddler seated in the canoe, which is built on the lines of the old Red Indian birchbark craft.

Canadian Pacific Rly.; Canadian Govt

Vancouver (upper picture) is Canada's great west-coast port and youngest major city. It is strikingly situated on the south shore of Burrard inlet, British Columbia, within sight of the mountains of the Coast Range. Its magnificent harbour has made it Canada's chief outlet to the Pacific and the Orient, and one of the world's principal grain ports The city is also important as a manufacturing centre. Quebec (lower picture), capital of the province of that name, is situated on the St. Lawrence, and most of its inhabitants speak French. Walls built in the 19th century stand on the site of the original fortifications, and behind them and looming over the old town is the Château Frontenac. Much of the city's shipping trade has passed to Montreal, but it is a centre of the lumbering industry, and has numerous manufactures including machinery, boots and shoes, and leather goods.

Canadian Pacific Rly.

Canada produces more oil than any other country in the British Commonwealth, and the outstanding feature of Alberta's recent development has been the wide discovery of oil and natural gas deposits. Oil-mining and farming are carried on side by side in that province (upper picture). Every year more than 250,000 men harvest the valuable pulpwood from Canada's forests. During the spring log drive men work ceaselessly to keep the timber moving downstream to the mills (lower picture). The forests also provide quantities of timber for export.

Canadian Govt.

For centuries the fisheries have formed the chief industry of Newfoundland, and the richest grounds are the Newfoundland Banks, where there is a seemingly inexhaustible supply of marine organisms upon which cod and other fish feed. These fishermen are placing split fish in the sun to dry.

Canadian Pacific Rly.

Wheatfields stretch across the prairie provinces as far as the eye can see, and at harvest time huge combine harvesters, similar to that on the left in the bottom picture, take the grain to elevators, whence it goes by rail to ports on the Great Lakes, such as Port Colborne, Ontario (upper right), where it is poured down chutes into the holds of vessels for export, principally to the United Kingdom. Canada is one of the world's foremost food producers.

CANADA: MAP OF THE GREAT DOMINION

Note. The provinces of New Brunswick and Prince Edward Island on the Atlantic seaboard are here indicated by N.B. and P.E.I. respectively.

timber come chiefly from British Columbia, Alberta, and Nova Scotia.

Intensely mechanised cultivation and vast spaces of rich soil have made Canadian farming famous. As the population of the earth keeps rising, Canada becomes more and more important as a world granary. By far the greater proportion of her 600,000 farms are in the south, but there are areas to the north which are fit for cultivation should the need arise.

The tremendous volume of wheat exports has given many people abroad the impression that the Canadian farmer is chiefly a grower of wheat. But this is not so. Grains such as oats for feeding cattle, sheep, and poultry are the chief products, and only between 15 and 25 per cent. of the total farming income comes from wheat.

Another wrong impression is that Canadian farms tend to be of enormous size compared with elsewhere. In fact, thousands of farmers own no more than 100 to 150 acres, and even on the prairies 300–600 acres is about the normal. Most farms, indeed, are run by one family with hired help at harvest time, and the tendency for young people to leave the land and go to work in the town is as pronounced in Canada as it is in most places. So machines must more and more do the work of men, and there are always jobs going for agricultural workers who have the knowledge and skill to handle specialised implements such as reapers and binders.

In most provinces mixed farming predominates, with small herds of dairy or beef cattle and modest flocks of sheep and poultry, and with the necessary acres under grain to feed them through the long winters. In the farthest-south area of Ontario, where the climate is moderated by the Great Lakes, there is a great deal of fruit farming, especially of sweet cherries, peaches, and melons. Tobacco is grown there, too, and sugar beet. British Columbia, behind its great barrier of the Rocky Mountains, has sheltered valleys where apricots ripen, and this province is the biggest apple producer of all.

Most farms have electric light and power, and farmers have their own cars. Dirt roads lead to the villages and small towns, from which, in turn, hard roads lead to the larger centres. The old isolation has gone. There are about 5,000 clubs throughout the farming country specially for young people. Here they can get together to study farming and also have a good time. Schools and colleges for agriculture have been set up, too, in most provinces.

In southern Alberta and the neighbouring south-western corner of Saskatchewan a big acreage has been supplied with irrigation from the local rivers, and grows sweet corn and peas to supply the freezing and canning factories which have been established there.

New Brunswick, Nova Scotia, and Prince Edward Island in the east are well suited to the growing of potatoes. In general, milk and meat come from the farms nearer the towns while those

National Film Board

CANADA'S NATIONAL WINTER GAME: ICE HOCKEY

Claimed to be the fastest game in the world, ice hockey has become Canada's national sport. It is played by men and boys wherever they can find a sheet of clear ice—on frozen ponds, neighbouring ice-rinks, and on the huge artificial ice-arenas. A puck, a round flat disc of vulcanised rubber, is used instead of a ball; and the skates resemble those used in races, but have shorter blades. There are six men a side; and the game lasts for three 20-minute periods.

FLYING FARMER OF THE CANADIAN PRAIRIE

Although Canada is now among the leading manufacturing countries of the world, agriculture is still the most important primary industry. Canadian farms are highly mechanised. Most of them range only up to about 600 acres in size ; but this farmer has a huge holding, and travels by light aeroplane to keep check on his men.

farther from them concentrate more on pigs for the bacon factories, with poultry and potatoes according to soil and climate. A very thriving and specialised activity near the bigger towns is the growing of vegetables, such as tomatoes, under glass with electric heating.

In fact, Canada can supply herself with all the essential food she needs to eat. Of course she must import tea, coffee, cane sugar, and warm-climate fruits, but among the great farming countries she is an exporter. She can grow more than she needs to consume.

Of all the wonderful natural resources with which Canada is blessed, the most impressive is her water power. The vast blanket of snow which covers the land in winter thaws in spring to form almost uncountable streams and rivers and thousands of lakes which are natural reservoirs. The lie of the land in many places makes for falls and rapids, ideal places in which to dam the flow and create a head of water to drive turbine generators.

All Canada's great industrial output has been built up on the cheap electric power that her rivers supply. The pulp and paper industry alone uses 20 per cent. of it. And there is no doubt that the high standard of living in the towns and cities is partly due to the almost unlimited supplies of hydro-electric power. Her capacity in this respect is already the largest in the world except that of the U.S.A. Improved technique in long-distance transmission and the use of high voltage make it possible to use generating plant farther away from the big centres as these grow with the rapidly growing population and new factory building.

Of course, there is far more water power available than can be used. It exists in the thinly peopled northern parts of the provinces—and this means that whenever mineral resources are worked there the same cheap power will be available. Quebec has the greatest amount of water power so far developed by any province. One of the most spectacular projects here is the Bersimis power-house, built right inside a mountain. Its eight turbines are housed in a great room, 565 feet long, 65 feet wide, and 80 feet high, hollowed out of the solid rock.

Some of the central electric stations are owned by the federal or provincial governments or by towns and cities ; others are in private hands, and over 90 per cent. of the current provided by them is generated by water power.

When we turn to the natural wealth beneath the surface—the long list of minerals which the world increasingly wants and Canadian prospectors seem continually to find—it seems as if Canada were a vast cave of hidden treasure.

Since 1950, mineral production has been increasing in a way undreamed of before, mainly through the tremendous and typical energy with which a great oil find at Leduc, Alberta, in 1947, has been followed up. Vast sums were spent in search for new sources, and these have been found both in the same province and in Manitoba and Saskatchewan. Besides the oil wells there have also been established wells for natural gas, and much of this is piped across the American border and sold very profitably. No sooner was this scheme completed than plans were afoot to build a huge pipeline 2,250 miles long to take more gas right across from Alberta to Toronto and Montreal, and yet another line from the Peace River ore-field.

Uranium began to be mined in 1955 at Blind River, in northern Ontario, and then another field was found in the Beaverlodge area of Saskatchewan. Canada thus became, almost in a matter of months, a leading producer of uranium in the world.

There is, too, a tremendous iron-ore production, and typical of Canadian methods was the driving of a special railway from newly-found deposits in a remote part of northern Quebec to the shores of the St. Lawrence River whence they could be shipped. In 1955 a new open-pit iron mine was started in Ontario, also with a special railway, to Picton on Lake Ontario. Here loading gear was set up that is able to fill the hold of a 10,000-ton ship in six hours.

Great quantities of zinc, nickel, and copper are also mined, while Quebec has the remarkable Black Lake asbestos mine. Deposits were found in the bed of the lake, and as the water was a nuisance it was just drained away. This mineral is mined in British Columbia, too. The long list of metallic and non-metallic minerals also includes columbium and lithium, which are needed in an age of atomic power and jet engines.

Nothing shows the Canadian spirit more revealingly than the spectacle of some uninhabited stretch of utterly wild forest land converted in a year or so to a great mining plant or oilfield in full, roaring production.

Many people still think of furs as important items of Canada's produce, though this source of wealth has long ago been eclipsed by industry. However the famous Hudson's Bay Company, which has been operating for three hundred years in Canada's north, still runs fur sales in New York and London. The furs are brought in by Eskimo and Indian or white trappers to one of the Company's 200 fur trade posts. But the "posts," romantic as they sound, are nowadays just very up-to-date general stores. "The Bay," as this type of local store is called, caters for settlements all over the far north of Canada, and when a new mine or water-power project begins, a boat or a railway freight wagon serves the Company and its customers until a building for yet another store can be put up.

The fisheries of Canada exist mostly to serve a steady export market, especially for the salt cod of the Atlantic and Newfoundland to South America and the West Indies; and the sock eye Pacific salmon for the canning trade. The Great Lakes are fished by agreement with the U.S.A. Lake Winnipeg and the Great Slave Lake have their own fresh-water fisheries producing trout, whitefish, and pickerel (young pike.)

The hustle and drive of Canadian living and working would of course be impossible but for a

Courtesy of Canadian Govt.

STREAM OF SALMON ON ITS WAY TO THE TINS

Its rich and extensive fisheries were the first of Canada's natural resources to be exploited by Europeans. Salmon provide the most valuable catch in Canadian waters, and the rivers of the British Columbian seaboard are sometimes jammed almost solid with the fish. Most of the salmon caught on the Pacific coast are sent to canning factories. The freshly-caught fish seen here are being speeded by Indians along the conveyor-belt which takes them into the factory.

system of transport and communications to serve them. The two great railway systems, crossing the continent from Atlantic to Pacific, Canadian Pacific and Canadian National, made the growth of the prairie provinces possible and linked the whole country. Now a great new road is under construction, also from ocean to ocean. It runs from Sydney, Nova Scotia, to Vancouver, a distance of over 5,000 miles. The road has been planned by good standards; the motorist must be able to see a minimum distance of 200 yards ahead at any point and there are parking strips on both sides. The completed highway will provide one of the world's finest car-trips, along the Great Lakes, across the golden prairies, and through the awesome peaks of the Rockies.

The other great new travel system is the St. Lawrence Seaway. (*See* ST. LAWRENCE.)

Canada's railways will be vital to her for many years to come because they provide a service which is far less dependent on the severe weather than road or air transport. And while in terms of speed, rail travel (often on single-line track) cannot compete with flying, the slower journeys offer the greater comfort and much more chance of enjoying scenery. In 1955 the railways put on new equipment by which the journey from Vancouver to Montreal could be cut by 16 hours.

The two chief civil air corporations are Trans-Canada and Canadian Pacific. The latter was formed from an amalgamation of small operators running services in the far north. Now it has grown to the extent of running a regular cross-polar flight from Amsterdam to Vancouver, where passengers connect for Australia and the Far East, saving 1,000 miles by taking this route. "TCA" serves the broad expanse of Canada herself and maintains regular services to London and Düsseldorf, New York and Seattle, Florida, Bermuda, and the Bahamas.

Operations in the Northern Territories and Yukon naturally depend to a great extent on air service for supplies, also for reconnaissance and the preliminary prospecting. Amphibious aircraft are much used, because the innumerable lakes are ready-made landing places. Small aircraft are used by farmers for crop-spraying, by forest wardens for fire control, and by game wardens for spotting poachers.

The People of Canada

What kind of people are they who live out their lives in this rich and highly productive country?

The majority are immigrants from Europe, from many different lands, who are united, in the first place, in wishing to adopt new citizenship, and also by the fact that they and their children learn to speak the English language.

The largest groups are the British and French. The French were the first Europeans to colonise Canada. When deserted by their own countrymen after Wolfe's victory at Quebec, and offered American citizenship by the insurgent American colonists of 1775, they preferred to live under the English, even though they disliked them, because they felt that their faith and their way of living would be tolerated. This continuing French cultural tradition has made a great contribution to Canadian life.

British immigration was very slight until the American War of Independence, when the American colonists who remained loyal to this country formed the United Empire Loyalists and shifted their homes to Canadian soil.

At about the same time thousands of Highlanders left Scotland after the disaster of the Young Pretender, and made their way to Canada. These three groups, French, English, and Scots, formed the core round which the immigrants from Europe accumulated in the 19th century. The coming of the transcontinental railway in the 1880s greatly hastened settlement.

During the Industrial Revolution, when Britain was changing from a community based on the land and farming to a community of manufacturing and clerical workers, many people who suffered hardship and unemployment sought a new chance in Canada. At the first Canadian census, in 1881, almost 60 per cent. of the population was of British descent and 30 per cent. of French. The proportion of French inhabitants was about the same at the

Courtesy of Canadian Govt.

TIMBER FELLING MADE EASY

With his power-driven saw this lumberjack is making two parallel cuts on the side of the tree facing the direction in which it is meant to fall. The steel helmet protects him from falling branches when men are aloft cutting away the upper branches of a tree.

1951 census, but the British proportion had then dropped to 46.

It is interesting to note that the figure for native Indian and Eskimo inhabitants was 1·2. Their numbers had increased since 1881, but they had been swamped by the hundreds of thousands from Germany, the Netherlands, Scandinavia, and the Ukraine. In the nine years following the Second World War over 380,000 British immigrants entered Canada and nearly 900,000 came from other European countries, among which Germany and the Netherlands were the chief contributors.

Though their parents may look back to a European past, the children of these new arrivals go to a Canadian school, are brought up to speak English, and from that moment are Canadians. They grow up in an atmosphere of great opportunities for "getting on." Wages are high, and so are the rates of spending. Hire-purchase is on a tremendous scale.

Community life, among people of the same age-groups, is the rule, and no one pulls the blinds down in the evening. Family life is lived in full view of the neighbours. The local church is a lively centre of many social activities and people go to church on Sundays more than they do in Britain. A television microwave, network in process of being developed from coast to coast will help in unifying Canadians.

Courtesy of Canadian Govt.

CANADIAN INDIAN TRAPPER SKINNING A FOX

The Hudson's Bay Company was founded in 1670 to trade in fur with the Canadian Indians, and it still has fur trading posts throughout the Canadian Arctic. The fur trade, however, is now no longer the most important in Canadian economy. The Cree Indians are noted trappers, and this Cree tribesman is removing the pelt from a fox.

Outdoor life is lived to the full. In summer everyone who possibly can gets hold of some kind of hut on river, lake, or seashore, where the family can sail or bathe or fish. In the winter there are usually ski slopes within easy reach and skating and curling to be had as easily. The greatest Canadian sport is ice-hockey.

The story of the modern Canadian people begins in comparatively recent times. In 1497, John Cabot, an Italian merchant sailor, sailed from Bristol in an English ship to find a new way to India, landed on the eastern coast of Canada, and at first believed he had reached China. It is improbable that he was the first European to set foot on Canadian soil—Norsemen may well have preceded him as far back as the outset of the 11th century. But Cabot's voyage was the practical beginning of the development of Canada, and he can properly be given the credit for its discovery.

Cabot's example was followed, some forty years later, by a Breton sailor named Jacques Cartier, who sailed up the St. Lawrence as far as the spot where Montreal now stands. By then it was realized that the land on the other side of the Atlantic Ocean was America, not Asia, so the object of the explorers became the finding of a way through to the Pacific Ocean—the "Western Sea," as they called it. English voyagers looked for a "north-west passage" by way of Hudson Strait and the Arctic Ocean; the French preferred the valley of the St. Lawrence and the Great Lakes. Eventually both efforts were successful.

It was not until the early years of the 17th century that any attempts to colonise Canada were made. And here the first great name in Canadian history comes into the story. In 1603 a Frenchman named Samuel de Champlain sailed up the St. Lawrence, and a year later helped to set up the

first French colony in North America, in what is now Annapolis, Nova Scotia. In 1608 he founded Quebec. In 1615 he reached Lake Huron. He blazed the trail for missionaries, traders, and settlers, and soon they were making their way to Lake Huron and the country beyond.

Whether told in French or in English, the tale of the penetration of Canada is one of the world's greatest adventure stories. The pioneers endured tremendous hardships, and in battling their way through the dangers of an unknown land had to beat off the attacks of the Indians, who, not unnaturally, resented this intrusion into their territory—and resented still more bitterly the attempts of French missionaries, chiefly Jesuits, to convert them to Christianity.

But by 1763, when the French ceded New France, as they called their possessions in Canada, to Great Britain, two sons of a western fur trader had sighted the foothills of the Rockies. Thirty years later Alexander Mackenzie crossed the Rockies by Peace River Pass, and completed the last stage of the overland journey to the Pacific.

While the French were active in this way, Englishmen were looking for the north-west passage. Hudson Bay takes its name from Henry Hudson, who in the search had sailed into this vast inland ocean. A company—the famous Hudson's Bay Company—was formed to trade in the lands around its shores, and its traders tried to push on to the west. But the reward eluded the early pioneers. That a north-west passage did exist was not, in fact, proved until 1859, when records were found of an expedition led by Sir John Franklin, a British naval officer, twelve years earlier. He perished in the attempt, but he showed the way. In 1906, Roald Amundsen, a Norwegian explorer, voyaged through the Arctic from the Atlantic to the Pacific.

The bitter rivalry between England and France in the 18th century had its echo, of course, in Canada, and for many troubled years the British and French settlers were at one another's throats, both sides making use of Red Indian allies. Then in 1759, General Wolfe won a great victory at Quebec; in 1760 Lord Amherst's successful campaign ended with the surrender of the French at Montreal; and in 1763 a peace treaty was signed. Britain allowed the French Canadians to retain their religion, language, and schools, so that to-day they are still French-speaking, and over a third of Canada's people are Roman Catholics.

A great reinforcement of the English-speaking population took place after the War of American Independence (1775–84), when upwards of 40,000 loyalists, preferring to remain under British rule, left their homes in the United States and settled in what are now Nova Scotia, Ontario, and New Brunswick. Trouble broke out between them and the French Canadians, and an attempt was made to ease the situation by dividing Canada into two provinces—Upper Canada (English) and Lower Canada (French). The difficulties were not really solved until 1867, when the Dominion of Canada was set up by the British parliament.

Before this happened, however, immigration from Britain and the U.S.A. steadily increased the English-speaking stock of the nation. The western provinces, as well as Ontario and the maritime provinces, were settled in this way; people from the Scottish Highlands brought Manitoba into being, and Vancouver Island was a Crown colony before the middle of the 19th century.

Government, Police, and Defence

In the beginning, under the French, and for the first thirty years under the British, the country was governed by officials sent out from the home country. When it was divided into Upper and Lower Canada, the English-speaking and French-speaking units were both granted their own governing assemblies made up of elected representatives of the people. But their powers were too small, and violent agitation for reform led in 1837 to armed rebellion.

As a result of a commission under Lord Durham, sent out to compose these differences, Upper and Lower Canada were united and given their own parliament, and British troops were withdrawn, leaving Canada to undertake her own defence. And so to 1867, when the agreement of Nova Scotia, New Brunswick, Quebec (Canada East), and Ontario (Canada West) to unite in a single Dominion was confirmed by the British parliament.

Development after that was rapid and spectacular. Only two years later the new Dominion bought the vast lands owned by the Hudson's Bay Company. Out of them came the provinces of Manitoba (1870), Saskatchewan, and Alberta (both 1905). British Columbia joined in 1871, Prince Edward Island two years later. The latest addition is Newfoundland, which was merged into the Dominion in 1949.

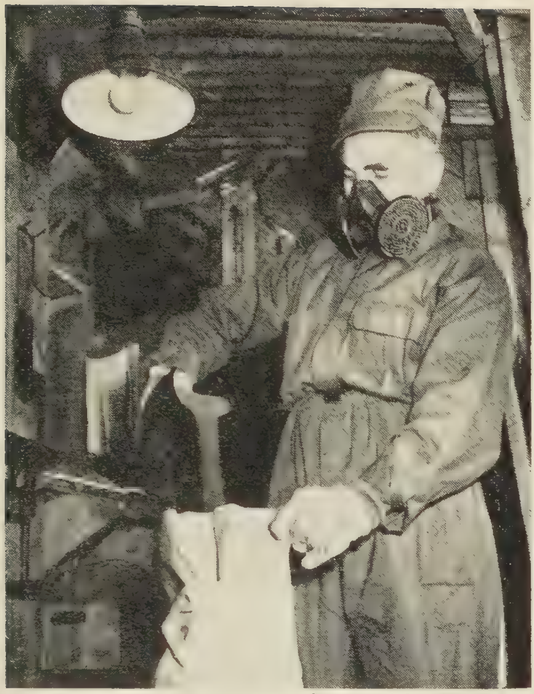
These provinces, with the territories of the Yukon and the North-West, make up the great nation Canada is to-day. The seal of its complete independence came in 1931 when the Statute of Westminster confirmed its status as a sovereign state. As a result Canada gives its allegiance to the British Sovereign, and belongs to the Commonwealth of Nations, entirely of its own free will.

The Sovereign's representative in Canada is the Governor-General, appointed on the advice of the government in Canada. He is the nominal head of the government, but, like the Sovereign, he acts only on the advice of his ministers. Since 1949 he has had the assistance of Canada's own privy council. As in Britain, ministers of the government of the day form a Cabinet, headed by a prime minister who is the real executive chief.

Parliament is organized—again as in Britain—into two houses: an upper house known as the Senate, to which representatives of the provinces are officially appointed for life, and a lower house or House of Commons, the members of which are elected by the people.

Each of the provinces has a Lieutenant-Governor, appointed by the federal government, and an elected legislative assembly. Only the province of Quebec has a second house. It is known as the Legislative Council and, like the federal Senate, is appointed by the government.

Canada has the most celebrated police force in the world, the Royal Canadian North-West Mounted Police—the "Mounties," as they are popularly called. Their "beat" ranges from the great industrial cities of Canada to the islands around the North Pole, and the tenacity with



Courtesy of Canadian Govt.

PACKING URANIUM ORE

Another of Canada's natural resources is her mineral wealth, which includes uranium—a main source of atomic energy. This workman at Port Radium, on Great Bear Lake, is packing uranium ore and wears a mask to give protection against radio-active dust.

which they seek out wrongdoers is proverbial. Few of them are mounted on horseback, much of the force being mechanised ; they use nearly 1,000 cars and over 30 seagoing vessels, as well as aircraft and motor-boats. In the north, however, they must still use dog-teams and sleighs.

Because Canada is an independent nation, it follows that it is responsible for its own defence and must maintain its own army, navy, and air force. The part that these forces played in the two World Wars has passed into the history of the British Commonwealth. Then, with " blood, toil, tears, and sweat," Canada's grand fighting men proved to the uttermost their allegiance to their sister nations and their King.

The Canadian contribution to the defence of the free world includes the provision of ships and aircraft for the forces of the North Atlantic Treaty Organization, and chains of radar stations across the whole country, including one in the far north, as part of the early warning system in case of air attack over the top of the world. This great and elaborate defence network is shared with the United States.

The largest city is Montreal, in Quebec province, with a population of well over a million ; it is the chief commercial and grain-exporting centre, and the biggest inland port in the world. Quebec, the capital of the province, and perhaps Canada's most historic city as well as one of its great river ports, is the home of 170,000 people. Toronto, the capital of Ontario, has a population of nearly 668,000 (" Greater " Toronto claims 1,348,000), and is famed both for its shipping interests on the Great Lakes and as the chief industrial and financial centre of the country.

The federal capital of Canada, and therefore the seat of the Governor-General and the government, is Ottawa, also in Ontario. Its population is 222,000. The populations of the other principal cities are given in the panel on p. 199.

Education, Religion, Literature

The boys and girls of Canada are fortunate in that the progressive ideas of their country give everyone the chance of an excellent education. Each province is responsible for the educational arrangements within its boundaries, the cost being met out of local taxes. Every city and town of any size has its high school, collegiate institutes, and business colleges, and every province has one or more universities. Some of the Canadian universities, such as those of Toronto, Montreal, and McGill (the oldest of them all), are world-famous. Special arrangements are made for the education of children, of whatever race, in remote parts of the country ; at Aklavik, only 80 miles from the Arctic, for example, there are two boarding schools for Indian and Eskimo children.

Canada believes firmly in the right of all men and women to worship God in their own way, and so one would expect to find there followers of a great variety of religious creeds. There are, in fact, well over a score of them, the largest in numbers being the Roman Catholic, with over 6,000,000 members, the United Church of Canada, with nearly 3,000,000 members, and the Anglican Church, with over 2,000,000 members.

Although Canada is still a comparatively young country in the world of music and the arts, here, as in other fields, there is vigorous life. Art exhibitions are well attended, and there is plenty of interest in painting and sculpture. A Dominion Drama Festival is held every year, and there are flourishing repertory companies in the chief cities. Toronto, Montreal, Winnipeg, and Vancouver all run their own full-time symphony orchestras.

The country has been evolving a literature of its own, in both English and French, since the pioneer days, and some of the works of its writers, poets, and novelists are finding a permanent place in the bookshelves of the world. The nature of the country and its life naturally influenced much of the earlier writing, so that books of history, biography, travel, and exploration were the chief literary productions. But as early as 1832, when John Richardson published *Wacousta*, a stirring tale of the war of 1812, the Canadian novel was making its appearance.

The long list of Canada's notable writers and poets grows steadily, and many of them are famed far beyond the borders of their own country. Many British children know the character "Anne of Green Gables," created by Lucy M. Montgomery (1874–1942). A humorous writer, in his day equally popular on both sides of the Atlantic, was Stephen Leacock (1869–1944).

In other fields of personal achievement perhaps the best-known Canadian name is that of Sir Frederick Banting, who, as the discoverer of insulin (see article), is certainly among the great benefactors of the human race.

MAN-MADE RIVERS, GREAT *and* SMALL

Canal. In the early days before wheels were invented, water was obviously the easiest means of transport. Passengers and goods could be loaded on to boats, and moved down stream, up stream, or across. Consequently the early great civilizations grew up in the valleys of rivers such as the Nile or the Euphrates. Even when roads and wheeled transport developed, water was still found to be the cheapest way of moving goods in bulk. Hence when new towns grew up away from the rivers, they were drawn to digging artificial waterways or canals to connect with one another or with a navigable river, in order to cheapen the transport of their goods.

A river is flowing water, fed by wells and tributaries, and its surface is always a slope. A canal is still water, and its surface is level. Hence canals could be built only in very flat country until locks were invented in the 14th and 15th centuries by the Dutch and Venetians. Canal locks are situated at the junction of a high-level and a low-level reach of canal, and consist of watertight masonry boxes, with a pair of movable gates at each end. When a barge is going up stream, the upper pair of gates remain closed, and the barge proceeds into the lock. The down-stream gates are then closed; and water is admitted into the lock so as to raise its water-level—and the barge—to the upper level. The process is reversed for down-stream traffic. The first lock in England was built on Exeter Canal by John Trew of Glamorgan, between 1675 and 1697. Locks enable canals to cross quite high hills.

Though there is no flow through a canal, there is a continual loss of water by leakage through the sides and bottom, and by the operation of the locks. The level is kept constant by the tapping of near-by rivers and wells, and by pumping water up to reservoirs where canals cross hills. To reduce the loss of water in opening locks, vertical lifts are sometimes substituted. These are watertight boxes in which barges can float; and the boxes are lifted to the high-level reach by hydraulic or electric power. Lifts save time in transit, but are unsuited to the transfer of the larger ocean-going vessels. The lifts on the Dortmund-Ems canal can lift a 600-ton barge up 46 feet.

Until early in the 20th century, barges were generally hauled by horses—or even men—walking on a towpath. Now they are generally powered by diesel engines or towed by a tug. Even so, speed has not increased; for it has been found that any speed much above three miles per hour creates a wave which very soon breaks down and washes away the canal bank.

The early canals generally served for irrigation, drainage, or defence, as well as for transport. In 2000 B.C. the Egyptians dug a canal from the Nile to the Red Sea; and in the 6th century B.C., Nebuchadnezzar dug the Royal Canal from Babylon, on the Euphrates, to the Tigris. The longest and the oldest existing canal in the world is the Grand Canal of China, connecting the Pei-Ho and Yangtse rivers. Begun in the 5th century B.C. and finished in the 13th century A.D., it is 850 miles

GRAND UNION CANAL AT KING'S LANGLEY

The largest British artificial waterway, the Grand Union Canal, with its numerous branches, has a length of 240 miles. Except for a stretch of some five miles west from Braunston, Northamptonshire, which forms part of the Oxford Canal, it provides a waterway from London to Birmingham, a distance of 147 miles. There are 159 locks between Brentford and Birmingham. It takes craft up to 72 feet long, 7 feet wide, and with a draught of 3 feet 9 inches.

CANAL BOAT RECEIVING THE FINISHING TOUCH

Courtesy of "Illustrated"

Owners of barges, correctly called flat-boats, on the inland waterways of the United Kingdom, display great pride of ownership. All metalwork is kept highly polished, and the craft, and even domestic utensils are painted. Castles and roses are the traditional subjects of boatmen artists, each with his own style, always gav in colour. These flat-bottomed vessels used to be towed by a horse or horses, but many of them are now fitted with an engine. The owner and his family live on board in quarters which, though cramped, are kept tidy and scrupulously clean.

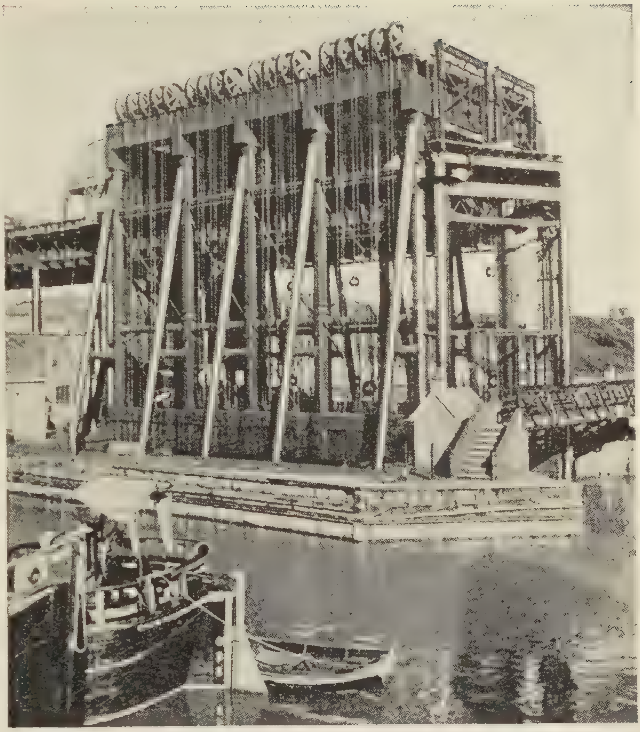
NATURE BEAUTIFIES DISUSED WATERWAYS

The canal linking Newport, Monmouthshire, with the river Usk near Crickhowell, Breconshire, was built for the coal trade ; but was unable to compete with the railways. A lock at Pontnewydd, Mon., is seen in the upper picture. The Kennet and Avon Canal (lower picture), which passes through Pewsey, Wiltshire, connects Reading and Bristol. Including the Kennet river and Avon river sections, it is 86½ miles long. Constructed in 1810, it became the property of the Great Western Railway (now Western Region, British Railways) in 1852 and was allowed to fall into disuse.

long. The Romans built a goodly number of short canals. In Britain they dug the Foss Dyke, 11 miles long, from Lincoln to the Trent at Torksey, as a defence work. This was deepened in 1121 to take boats, and was the first navigable canal in Britain. Charlemagne projected canals joining the Rhine, the Main, and the Danube, which have since been constructed.

The invention of locks made canals possible even in undulating country. The first modern canal was the Languedoc Canal or Canal du Midi, completed by Baron Riquet de Bonrepos in 1681 by command of Louis XIV. It connects two navigable rivers, one flowing into the Bay of Biscay, the other into the Mediterranean, is 148 miles long, has 119 locks, and at its highest point is 620 feet above sea level. This was the start of the existing French system of 3,000 miles of canals and 4,600 miles of navigable waterways.

The continent of Europe is very suitable for the development of water transport. There are numerous rivers navigable for great distances by large craft. By connecting all these with canals, waterborne transport can be made to serve most of the territory. There is plenty of water to keep the canals full; and even the high-level reaches over the passes can be fed from the higher mountains. After 1680 canal construction expanded in Europe and is still going on. A great work of the 20th century is the Albert Canal from Antwerp to Liége, though this was also built as a defensive



LIFT ON THE WEAVER CANAL, CHESHIRE

On a canal, lifts provide an alternative to locks. In a vertical lift the craft is floated into a counter-balanced tank, and raised or lowered vertically. Motive power can be electric or hydraulic. The Anderton lift on the Weaver Navigation Canal is a vertical lift.

REGENT'S CANAL, A COMMERCIAL WATERWAY

In a country setting, a canal, especially if it carries little traffic, is a joy to the eye, but when it is an artery of commerce it is very much less attractive. Instead of a splendid horse, a grimy tug hauls a string of dingy barges through the murky water. Regent's Canal is a London waterway, which was amalgamated with the Grand Union Canal in 1928. The eastern end is just north of the Thames, and it joins the Grand Union Canal in Paddington.

work. As a result of nearly two centuries' development, and by connecting great rivers like the Seine, Elbe, Rhine, Rhône, Danube, and Vistula, it is possible to take cargo by water from the Baltic to the Mediterranean and from the North Sea or Atlantic to the Black Sea.

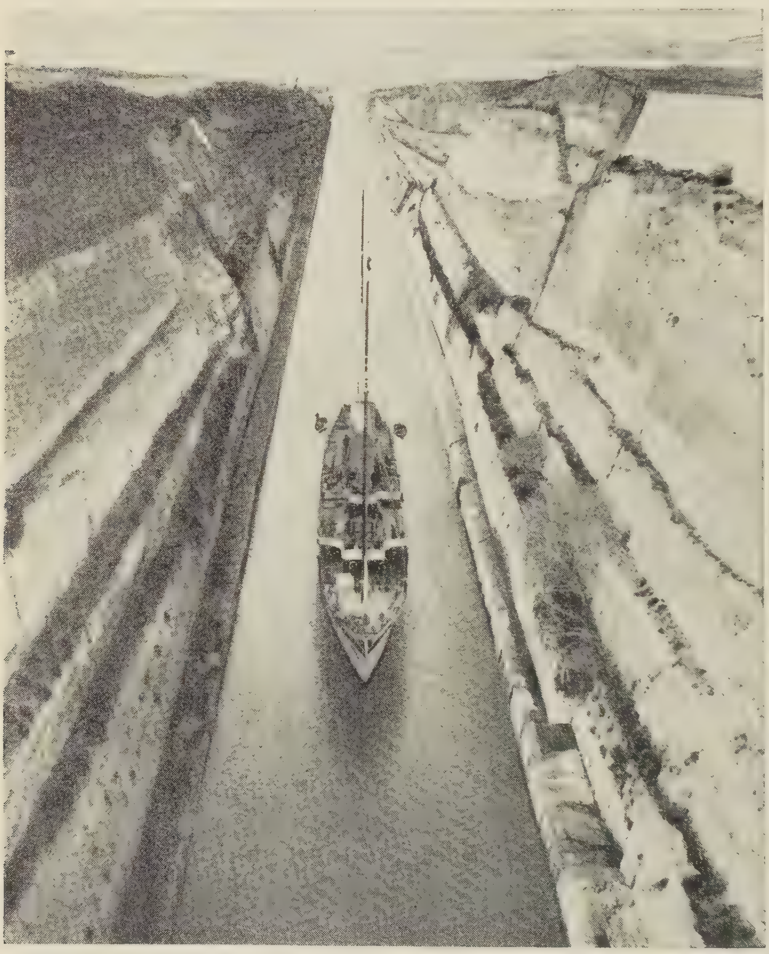
The U.S.A. built its first canal in 1837, and rapidly completed 4,500 miles. However, railway competition was too keen; and in the beginning of this century over half were out of use. Russia was slow to start; but since the Revolution the Stalin, Moscow-Volga, and Don-Volga Canals have connected the Black, Caspian, White, and Baltic Seas with Moscow. Russia has also connected the great Siberian rivers so that water transport from the Ural Mountains to Lake Baikal is now possible.

The "canal age" in England dates from the famous Bridgewater Canal. The Duke of Bridgewater is sometimes called the "father" of British canals. He owned collieries at Worsley, and seeking cheaper means than pack-horse to get his coal to Manchester, he commissioned James Brindley (1716–72) to build him a canal. It was completed in 1761, and reduced freight cost by nearly three-quarters. To reach Manchester, it was carried over the river Irwell on a famous aqueduct (see article) of three stone arches. Brindley could hardly read or write or set down a calculation, but he won fame as a pioneer of canal engineering. He designed 360 miles of canal; including a section through a tunnel 2,280 yards long. In the next 50 years many hundreds of miles of canals were built by different companies. Most of the companies prospered greatly; but when the "railway age" came in the 1830s, many sold out to the railway companies, and railway competition took much business away from the others. In 1948 some 2,000 miles of canal in the United Kingdom were nationalised and placed under the Ministry of Transport.

Canals serve a great deal of England, but are too narrow to take big boats. The average canal boat in England is from 30 to 70 tons, in France it reaches 300 to 1,000, in Belgium 300 to 375; and in Germany as much as 400 to 600; and the big boat pays. A royal commission recommended in 1909 that the canals of Britain should be broadened to take 100-ton or perhaps 300-ton boats, but nothing has been done. The canals carried several million tons during each of the World Wars; but their future remains in doubt.

The canal boat is the permanent home of its operator; and as such it is usually gaily painted and kept clean and polished like a battleship. It is mainly a family business, going from father to son; and the boat people are a race apart. As they rarely spend more than one night in any one town, the education of the children was a problem. This has now been met by the institution of a hostel at Woodend Hall, Erdington, Birmingham. Here the canal children live during term time, attending local schools.

Ship canals take ocean-going ships. Many cut an isthmus to save a long voyage; and among these are the Suez and Panama Canals (see articles), the Corinth Canal, the Kiel Canal, the canal from Gothenburg to the Baltic, and the now little-used Caledonian Canal in the north of Scotland. Others lead ocean-going ships to an inland port. Famous among these is the Manchester Ship Canal. Others include the North Sea-Amsterdam Canal; the Welland Canal in Canada, the Albert Canal, and the old Sharpness Canal, from Bristol to Gloucester.



YACHT PASSING THROUGH THE CORINTH CANAL

The Corinth Canal, a waterway of Greece cut through rock to a depth of 285 feet, was completed in 1893, having previously been attempted by the Emperor Nero. It connects the Gulfs of Corinth and Aegina, and shortens the voyage from the Ionian Sea to Piraeus, the port of Athens, by 202 miles. Blocked by the Germans in 1944, during the Second World War, it was re-opened to traffic in 1948.

OLD AQUEDUCT ON THE BRIDGEWATER CANAL

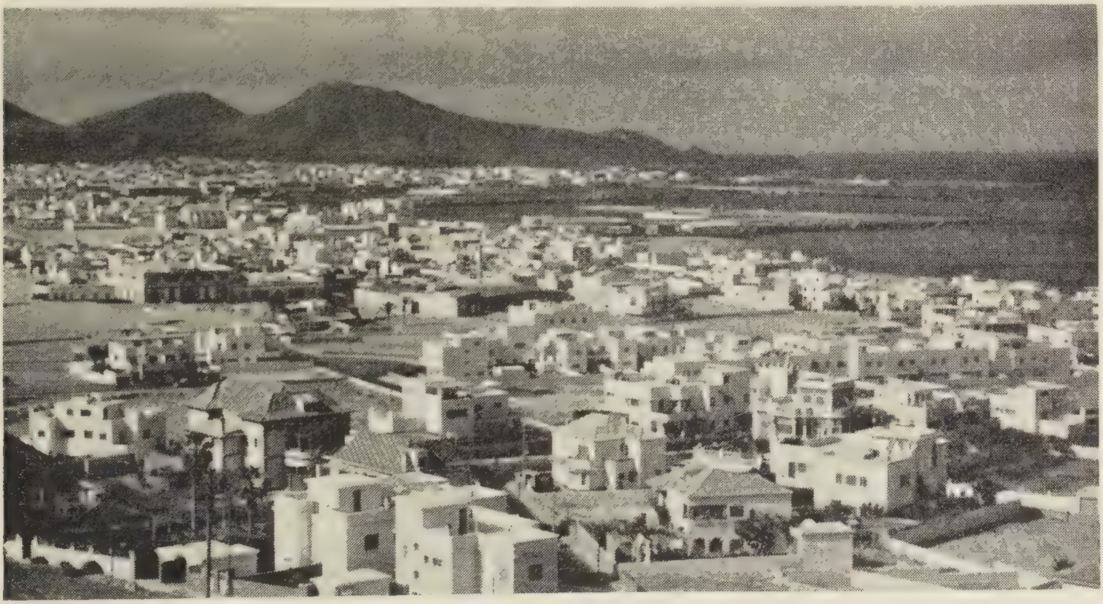
One of James Brindley's (1716–72) achievements was the construction of the Bridgewater Canal. He had to carry it over the Irwell at Barton, near Worsley, and this contemporary engraving shows the structure. It was 600 feet long and stood until 1893, when it was replaced by a swing aqueduct over the Manchester Ship Canal.

Canary. In its wild state the canary is to be found as a greeny-yellow, finch-like bird in the Canary Islands, the Azores, and Madeira. Its scientific name is *Serinus canarius canarius.* It is not native to the Continent of Europe and never migrates, so that any specimens seen in Great Britain flying about the open countryside have obviously escaped from captivity. To-day in England the practice of keeping cage-birds is not nearly so popular as it was fifty years ago, but canaries are still bred by fanciers here and many are imported from the Continent. Breeders aim at the producing of varieties which are healthy, pleasing to the eye, lively, and (as far as the cock birds are concerned) able to sing well.

There is a lot to be said for the canary as a pet, whether it be the long, straight "Yorkshire," the small and hardy "Border," the chubby "Norwich," or indeed any other type. It is a cheery little bird, and if it is housed free from draughts and stale air (including tobacco smoke) in a warm aviary or large cage (preferably wooden-sided), and has ample food, the friendship of the family, and plenty of clean water for drinking and bathing, it appears to be as happy as the day is long. Its pleasant little call-note and general air of optimism have helped many an invalid and lonely old person.

In view of the fact that practically all canaries to-day are bred of generations of captive birds, there can be no cruelty in having this yellow sprite as a pet. Carefully looked after, it may live twelve years or longer. The delightful song of a really good cock canary is not only comparable with that of the best wild songsters, such as the nightingale and the sky-lark, but for strength, sweetness, vivacity, and variety is thought by many bird-fanciers to be pre-eminent.

Canary Islands. The first glimpse of the Canaries, which lie 60 miles off the north-west coast of Africa and between the Madeira and Cape Verde groups, is frequently the single snow-covered peak of El Pico de Teyde (12,185 feet),



LAS PALMAS, ON THE ISLAND OF GRAND CANARY

The Canary Islands, which are situated 60 miles off the north-west coast of Africa, have formed two provinces of Spain since 1927. They consist of seven principal islands and several uninhabited islets. Las Palmas, on Grand Canary, is the largest town. The rich volcanic soil and almost perfect climate make agriculture the leading industry.

SNOW-CLAD PEAK OF TENERIFE IN THE CANARY ISLANDS

The chief and largest island of the Canary Islands is Tenerife. It is of volcanic origin, and is dominated by the well-known Peak of Tenerife, which is 12,185 feet high and has a crater 300 feet in diameter and 70 feet deep. The mountain may be seen over 100 miles away. Despite the genial climate, its top is snow-covered in winter.

which dominates the island of Tenerife. In clear weather it can be seen at sea for many miles. Drawing nearer to the islands, the ship makes its first call at Santa Cruz, the capital (population in 1955, 111,600), also on Tenerife. The white, flat-roofed houses make a dazzling picture under the tropical sun, and presently the date palms, orange trees, bananas, and cacti come into sight.

The Canary Islands remain as one of the few possessions of the once mighty empire of Spain, forming two provinces of that country. They comprise seven principal islands—Tenerife, Grand Canary, Palma, Hierro, Gomera, Lanzarote, and Fuerteventura—besides a number of small uninhabited islands. The largest town is Las Palmas (population in 1955, 166,600), on Grand Canary. The chief products are tomatoes, onions, tobacco, and fruits—especially the familiar Canary banana. The total area is 2,808 square miles, and the population, mainly of Spanish descent, was 860,000 in 1955.

The Canary Islands may be the Fortunate Isles, or Isles of the Blest, of the Greek and Roman legends, and their existence was probably known to the Phoenicians and Carthaginians. They were not rediscovered, however, till the 14th and 15th centuries, when Spain colonised them despite attempts by French and Portuguese to gain possession.

The name comes from the Latin *Insula Canaria* mentioned by Pliny. Probably the modern Grand Canary, the island, was named from the large breed of dogs (*canis*) that were found there.

Canberra (pron. kan′bera). When the six states of Australia were preparing to federate as the Commonwealth of Australia, none of them would agree that any of the existing state capitals should become the capital city of the new nation. Accordingly the Commonwealth constitution contained a clause that the federal seat of government should be established within territory owned and controlled by the Commonwealth.

After various areas had been considered, a tract of sheep-grazing lands in the Yass-Canberra district at the foothills of the Australian Alps, 200 miles south-west of Sydney, was purchased from New South Wales in 1908, and vested in the Commonwealth on January 1, 1911. The district was named the Australian Capital Territory and had an area of 911 square miles. Where the Australian capital now stands there was only a little township with a few hundred inhabitants. In 1915 a patch of 28 square miles on the coast at Jervis Bay, approximately 82 miles south of Sydney, was acquired to make a port for the capital. The Royal Australian Naval College is situated here.

The new capital city was planned in accordance with the scheme drawn up by Walter Burley Griffin, a Chicago architect. The city is laid out like a cobweb, with most of the government buildings in the centre, from which streets radiate to the residential quarters. The foundation column of the new capital was laid in 1913, but the First World War delayed the city's construction, and from 1901 to 1926 Melbourne was the seat of government and the temporary federal capital.

On May 9, 1927, the first session of the Commonwealth parliament in Canberra was opened by the Duke of York, later King George VI. The headquarters of government departments were gradually transferred to the new capital. Buildings of the Australian National University, founded in

1946, began to go up in 1949. Also at Canberra are the national memorials to those who fell in the First and Second World Wars.

Canberra is a city of flowers and blossoming trees, and presents a lovely picture of the hills around and beautiful buildings bordering a great artificial lake made by damming the Molonglo river. Along the lake and stretching far back is an area of parklands unsurpassed anywhere else in the world. On the summit of the ridge overlooking the valley is the Capital Building, and just below are the Houses of Parliament. To the right and in front of the capital are government buildings, with the University and hospitals just across the valley. Canberra has a population of (1956) 34,189.

Australian Information Bureau

CANBERRA'S PARLIAMENT HOUSE

This fine building is Parliament House at Canberra, the capital of the Commonwealth of Australia ; and the first sitting of the Australian parliament took place there in May 1927. Canberra, founded in 1913, became federal capital in 1927.

Candle. Although the candle was one of the earliest forms of lighting, it is by no means out of date, as one soon finds when there is an electricity fuse ! It is curious, in days when electric light is almost universal, that we still measure its strength in "candle-power."

Candles were certainly known in England during the Roman occupation, and probably also among

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WELL-PLANNED SUBURBS OF AUSTRALIA'S CAPITAL

This air photograph of part of Canberra shows the liberal provision made in the suburbs for parks and gardens. The oval in the centre is a portion of the ground of Telopea Park school ; farther away and to the left is Telopea Park sports ground, with the suburb of Griffith beyond. The city was designed from plans submitted in an international competition in 1911 by Walter Burley Griffin. At Canberra is the Australian National University, founded in 1946.

the Saxons, first in the form of rushlights—the pith of rushes soaked in household grease. Somewhat later, but before clocks were used, a candle would be marked off in sections and the hours measured by the time it took to burn from one division to another—an hour, half an hour, and so on.

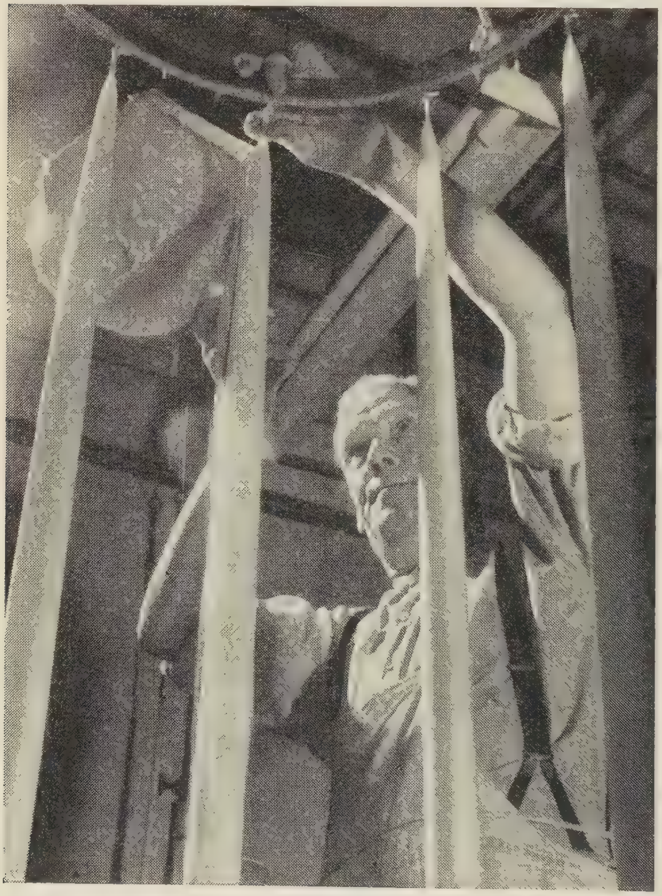
For several hundred years housewives used left-over beef and mutton fat to make their own candles, with flax for wicks, and one may well imagine the appalling smell when they began to smoulder. In the Middle Ages they were used more and more, and it is almost 500 years since the Worshipful Companies of Waxchandlers and Tallowchandlers received their charters as Livery Companies of the City of London.

Candle factories date from the beginning of the last century, and modern machines can turn out 500 at a time. It is a large industry, for candles range in size from the miniature ones on a birthday cake to those, several feet high, seen in churches. Tallow (still made from animal fat) remains one of the present-day ingredients. It is now specially purified and usually mixed with paraffin wax before being shaped in a mould around the fibre wick. The wicks are plaited, so that the candle burns evenly with no need of the old-time clipping or snuffing. Wax candles are made of beeswax, and the most expensive kinds contain spermeceti, a substance obtained from the head of the sperm whale. Nightlights, the small, dumpy relations of the candle, used mainly for children and invalids, were introduced in mid-19th century.

From the early days of Christianity candlelight has been used in church ritual as a symbol or reminder of the Light of the World. At the feast of Candlemas, celebrated in Roman Catholic churches on February 2, candles are blessed in church, lighted, and carried in procession. This custom has lasted for almost a thousand years; but the events it commemorates—the Purification of the Virgin Mary and the Presentation of Christ in the Temple—have been celebrated from much earlier times. The great Paschal candle, seen in some churches between Easter and Ascensiontide, is often elaborately decorated.

In recent years people have come to appreciate the soft glow of candles for decoration. They are made in a host of attractive shapes and colours, and some of them will burn for many hours. Ancient and modern are blended when fashionable electrical fittings imitate the exact shape of the age-old candle.

In times when candlesticks, extinguishers, clippers, and snuffers were everyday necessities, they were often beautifully made by craftsmen, especially in wrought metal, and these now represent some of the finest specimens of old handicraft to be seen in the museums.



A Shell Photograph

MAKING CANDLES FOR CHURCHES

Church candles still have to be made by hand, and in the photograph a further layer of beeswax is being poured down the length of a semi-completed candle to build up another layer of wax, the surplus being caught in a trough. These candles vary enormously in size.

Canning. Napoleon said that an army marches on its stomach, meaning that even the best-trained and bravest troops must be properly fed if they are to win battles. So it was very appropriate that the idea of bottling and canning food was first thought of for Napoleon's soldiers.

To-day nearly every kind of food can be bought, bottled or tinned, in all parts of the world, all round the seasons.

From very early times, meat and fish had been preserved by being dried or soaked in salt or smoked; and the drying of vegetables and fruits like beans, peas, currants, and raisins, kept them fit for eating long after they had been gathered. But dried or salted meat and fish and dried vegetables are not very tasty. Moreover, eating a lot of salted meat without fresh vegetables caused a terrible skin disease called scurvy, which was very common among troops in war-time, when fresh food was scarce, also on ships making long voyages.

Napoleon realized that much of the disease among soldiers on active service was due to the lack of fresh food, and towards the close of the 18th century he persuaded the French government to offer a prize of 12,000 francs (then worth roughly £600 in English money) to anyone who could invent a way

MOLTEN WAX FOR COLOURED CANDLES

Shell photograph

At the works of Price's Patent Candle Co., London, molten wax is being ladled from a supply vat for the candle-making machines in the background. The supply vats are filled by pressure from a central reservoir of wax. Despite many modern improvements, the making and colouring of the better type of candle have retained an element of craftsmanship which depends upon a fine delicacy of touch that no machinery can adequately replace.

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CANNING PLUMS IN AN UP-TO-DATE FACTORY

Chivers and Sons, Ltd.; Batchelor's Peas, Ltd.

In a cannery, the meat, fruit, vegetable, or other food is packed in cans, generally made of very thin steel with a coating of tin. In the top left picture, tins on a conveyor (see CONVEYOR) are passing workers, who fill them with fruit. The machine for sealing the cans is shown at top right. It deals with some 30 tins a minute. The sealed tins are placed in receptacles (lower picture) before being put into the oven for cooking and sterilising.

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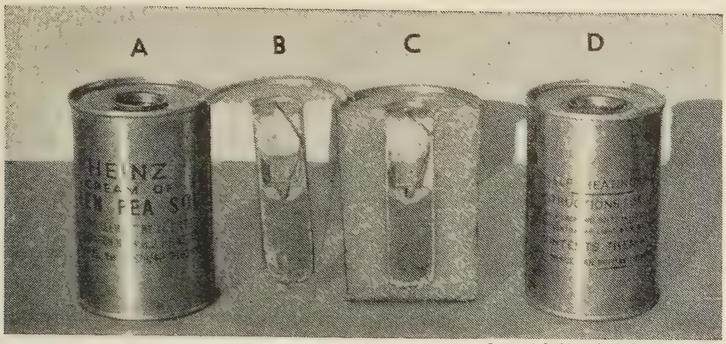


Imperial Chemical Industries

SELF-HEATING TINS OF FOOD

Above is a tin worked by a heating cartridge. A and D are opposite sides of the tin. B shows the centre section, with the cartridge and the igniter. A half section, with the heating assembly, is seen at C. Another type has a chemical heating element, which can be ignited with a lighted cigarette (right).

of keeping food fresh even when stored for many months. The winner was François Appert (1752–1841), a French chef who found that he could do just that if he thoroughly cooked the prepared foods and sealed them in airtight bottles.

François Appert, Pioneer

Appert had conceived his idea when asked by a dairyman at Gournay how to keep milk fresh. His advice was to bottle it and then to heat the bottles in boiling water for a short time. The dairyman did this, and the milk was still fresh after a journey to Rouen, then a matter of two days. Actually Appert had discovered a method of pasteurisation long before Louis Pasteur (see article), without knowing the theory.

Appert then tried preserving meat, fruit, and vegetables, and found that his process was just as successful as it had been with milk. It did not change the form, quality, or taste of the food; and when the bottles were opened many weeks afterwards it was difficult to tell the difference between bottled and fresh food. Appert thought wrongly, however, that the food had kept fresh simply because it had been cooked and sealed against the air. As was discovered by Louis Pasteur (1822–95), the real reason was that the heat of the cooking destroyed the bacteria (see article) which turn food bad.

Millions of bottles of food were prepared by the Appert process for Napoleon's armies ; and the method later became popular in all countries, both for military and for civilian use. Because bottles are easily broken, other types of container were tried. Thin iron was suggested, but it was found that the acids in many foods corroded the iron and made chemical compounds which either poisoned the food or gave it a bad flavour. The problem was solved by the use of iron containers lined with tin. These were first made at the Dartford iron works, near London, early in the 19th century.

To-day canning and bottling are vast industries, almost every step in the processes being mechanised. The prepared meat, fish, vegetables, fruit, or other food, is packed into cans generally made of very thin steel with an inner coating of tin. Cans to contain fruit are also varnished (lacquered) inside as a protection against the action of acid in the fruit. Lids are fixed to the filled tins, and these are then placed in large steam ovens and the food is cooked in a temperature ranging up to 270 degrees F., so that all harmful bacteria are killed.

A small hole in the centre of each lid allows the hot air to escape. Each hole is closed with a spot of solder immediately the tins leave the ovens, so that it is not possible for fresh bacteria to get in. The tins then undergo further cooking.

Bottling is done on the same general lines, a simplified process being followed in "home" bottling when surplus fruit is to be preserved for family use. The cleaned and, if necessary, cut-up fruit is packed into glass jars or bottles whose lids are screwed loosely on or held down by spring clips so that air can escape during the cooking. The containers stand in boiling water until this is complete, and then the lids are fixed firmly, so that no air can get in.

As fruit and vegetables should be dealt with as fresh as possible, bottling and canning factories are usually situated in areas producing the particular crops. Several areas in Britain specialise in this industry. Most foods, from sardines to pineapple, are canned or bottled in America. Australia, New Zealand, South Africa, Spain, and Portugal export enormous quantities of canned and bottled foods ranging over many kinds, Portuguese sardines being especially popular.

Vast quantities of tinned foods were consumed by the fighting services in the Second World War, and so that the meals would not always have to be eaten cold when all ordinary heating facilities, were lacking, self-heating devices were incorporated in many tins. This ingenious plan is shown in the pictures above.

Canterbury. Every since the time of Augustine, Canterbury has been the home of the English Church ; and the Archbishop of Canterbury is the Primate of All England. In 1067, about four and a half centuries after the death of St. Augustine, the ancient Roman church in which he had preached was destroyed by fire. The new cathedral or archbishop's church was begun by Norman architects and builders in 1070, during the reign of William the Conqueror, and was completed in 1495 after many misfortunes.

Canterbury cathedral (*see* picture, p. 288) towers

proudly over the old-fashioned Kentish city, and shops nestle close to its stone gateway with its charming ancient sculptures. In the close are the houses of the resident clergy and the old monastic cloister begun in the 11th century.

Flanking the western front of the magnificent cathedral are two fine towers ; but these are surpassed by the lovely central Angel Tower or Bell Harry. The Chapel of the Martyrdom was where Thomas Becket (see article) was slain in the 12th century. Becket was held to be a martyr and a saint, and pilgrims streamed to Canterbury to visit his shrine. The shrine was destroyed by Henry VIII, but grooves in the stone steps show where countless devout worshippers ascended to it. Chaucer (*c.* 1340–1400), in his *Canterbury Tales*, pictures a band of pilgrims on pleasure as well as religious duty, telling stories along the road (*see* CHAUCER, GEOFFREY). The poet Christopher Marlowe was born in Canterbury in 1564, and some of the incidents in Dickens's novel *David Copperfield* are set here.

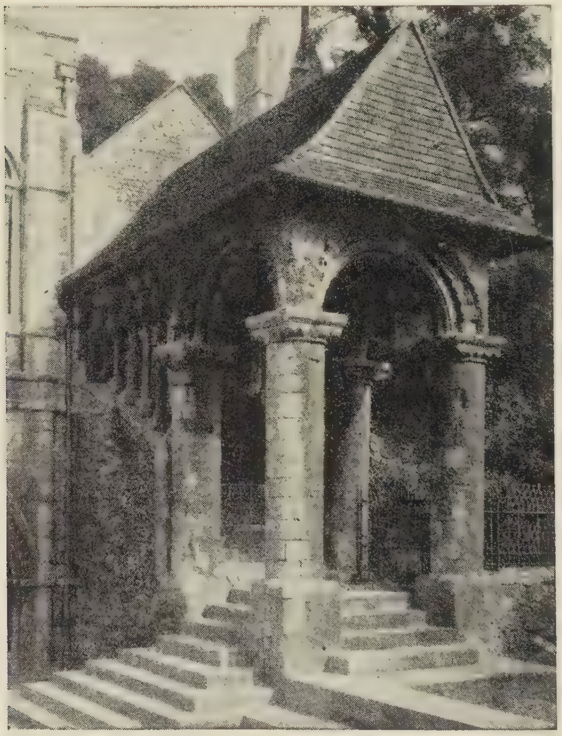
Along the river Stour there are now mills, tanneries, and breweries, and a thriving grain and hops trade is carried on. But the medieval houses with their overhanging gables, the Guildhall dating back to the 15th century, and St. Martin's church, reputed to date from the time of St. Augustine and to be the oldest church in England, bear witness to the city's ancient history.

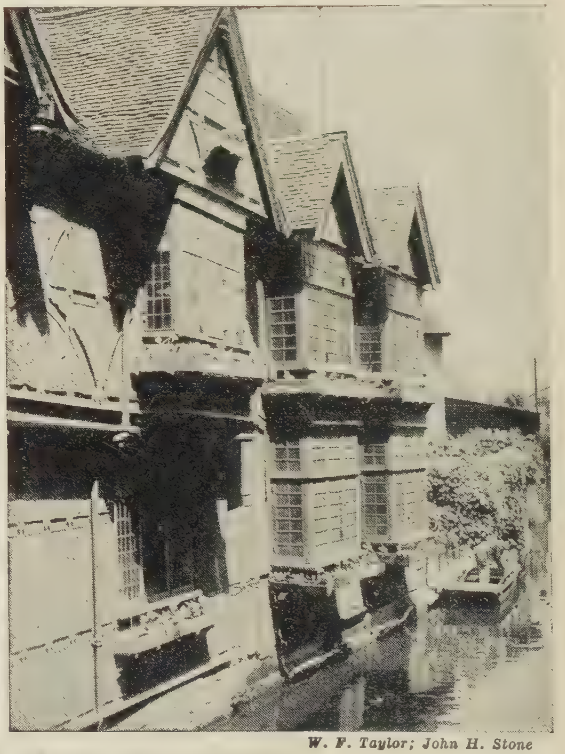
Ancient walls extend round the city for nearly two miles, and one of the six old gates—the West Gate—probably dates from about 1380. Outside the city's walls is the artificial mound, Dane John, from the summit of which an extensive view of the surrounding country can be obtained.

Already important in 55 B.C., when Julius Caesar came to Britain, Canterbury was given the name *Durovernum* when the Romans occupied it and made it a military station. Later, as the centre of the kingdom of Kent, it became known as *Cantwarabyrig*, or " Kentishmen's town." From the 9th to the 11th centuries it suffered greatly at the hands of the Danes, and again in the Civil War, when it supported the King. Canterbury was considerably damaged by German bombs during the Second World War air-raids, but the cathedral escaped lightly, although the library was destroyed. Marlowe's house and St. Augustine's Abbey suffered severely. While clearing the wreckage of bomb-damaged buildings, discoveries were made which threw new light on the Roman occupation. Some very interesting Roman mosaic pavements were revealed. The population of Canterbury in 1951 was 27,778.

Canton, CHINA. Canton, or Kwangchow, is the capital of Kwangtung province and the commercial centre of southern China. It is situated at the apex of the delta of the Chukiang or Pearl River, 80 miles from the sea. It is divided by canals and streams, so that some parts of the city are on islands. The climate is hot, but is certainly not weakening.

" Everything new originates in Canton " is a





W. F. Taylor; John H. Stone

CANTERBURY'S LINKS WITH FRANCE AND FLANDERS

Both warlike and peaceful invasions of England are commemorated in the buildings seen above. The beautiful old staircase at the King's School (left) dates from Norman times, and has the typical Norman rounded arch, which William the Conqueror (1066–87) and his architects brought to England. The Tudor houses that stand beside the Stour (right) are known as the Weavers, and were occupied by silk weavers who came from Belgium in the sixteenth century.

Chinese proverb. It was the first Chinese city to be opened up to foreign trade. Indian traders journeyed thither as early as about A.D. 700. The Portuguese opened trade relations in 1518, were followed by the Dutch, and a little more than a century later by the English. Most of the Chinese emigrants to foreign lands have come from Canton.

Chinese who were trained in foreign universities are largely responsible for modernising old Canton. They established municipal government, installed a drainage system, re-organized the police, and arranged for the deepening of Pearl River so that modern ocean vessels could reach the city. They tore down the old city walls, which were some six miles in circumference, and built boulevards in their place, and laid out public parks and wide avenues. The foreign quarter is on Shameen Island, connected with Canton by bridges, a settlement of tree-lined avenues and palatial homes.

Not all the city has been modernised. There are crowded, crooked streets so narrow that you could stand in the middle with arms outstretched and touch the side walls with the tips of your fingers. So old is the paving that hollows have been worn by the tread of millions of feet. The houses are low, with flat red roofs, and here and there are the tall towers of the pawnshops.

Of the more than 120 temples, the most famous is the Buddhist temple on Honan, an island suburb. Others of great fame are the Temple of Longevity, and the Temple of Five Hundred Genii (spirits), so called from the numerous statues of Buddha and his followers which it contains.

The wharves in Canton hum with activity, and thousands of boats jam the harbour, including guilded pleasure junks and flat-bottomed sampans or house-boats, in which some 50,000 citizens live. Many of these river folk are born, live, marry, and die in these floating homes. They form a complete community, with their own tradespeople, priests, teachers, and workmen, never living ashore.

Ivory and jade carvings, mother-of-pearl work, brass and silver ware, fans, embroideries, and hand-decorated porcelain are some of the products for which the city has long been noted, and the district around Canton is important for its exports of silk and matting.

Canton has long been a centre of revolutionary ideas. Here the first whisperings of the revolution of 1911 against the ruling Manchus were heard, and here the nationalist movement to unify China developed, resulting in the establishment of the Nanking government in 1928. The city was heavily bombed by the Japanese in 1937 and 1938 during the war between China and Japan. When the Japanese entered Canton on October 21, 1938, they found the centre of the city in ruins, whole blocks of buildings having been destroyed by the Chinese before their withdrawal. Most of the population had fled before the arrival of the Japanese, and Canton lost much of its commercial importance. After Japan's attack on the eastern possessions of Britain and America in December 1941, China became an ally of those Western powers; thus it was that American and Chinese bombers attacked the city during the Japanese occupation, which ended with the surrender of Japan in August 1945. The population of Canton is about 1,500,000.

CANTON'S CROWDED CREEK BY SHAMEEN ISLAND

It has been estimated that some 50,000 of Canton's inhabitants live in house-boats on the Canton River and its many creeks. This waterway lies between the island of Shameen (on the right), where is the foreign quarter, and the city of Canton proper. The house-boats are allowed to moor on one side of the creek only, in order to leave a channel free for traffic. The Pearl River has been deepened, so that ocean-going vessels can now unload here, 80 miles from the sea.

CANTON'S CENTRE OF BUDDHIST WORSHIP

In and about Canton there are upwards of some 120 temples ; one of the most famous is the Temple of the Five Hundred Genii (spirits), so called from the hundreds of statues of Buddha and his disciples. Another notable building is the Plain Pagoda, which dates from the 9th century and is now a mosque. Canton, the great commercial centre of southern China, was captured by the Japanese in October 1938, and remained in their possession until August 1945.

Canute (*c.* 994–1035). This great statesman and soldier was the son of Sweyn Forkbeard, king of Denmark, and of Sweyn's queen Gunnhilda, daughter of Burislav, King of Wendland on the Baltic coast of what is now Poland ; thus Canute was brought up in the first rank of the fierce heathen princes of Scandinavia. Sweyn renewed the Danish attacks on England. The line of Alfred and his successors had dwindled to the incompetent Ethelred II. He first bought the invaders off, then permitted a massacre of Danish settlers in England, and finally fled to Normandy before the vengeful Sweyn could capture him.

Sweyn was acknowledged king in England in 1013, but he died in the following year, and Canute, his second son, was declared king by the Danish war-host. For three years Canute's power was sternly contested by Edmund Ironside, Ethelred's son ; but Ethelred's death, Canute's victory at Assandun (Ashingdon) in Essex, and the murder of Edmund in 1016 left Canute undisputed king. Sending most of his Danes away, he kept a guard of 6,000 wickings (or " vikings "), and set himself to pacify the English. To this end he married Ethelred's widow Emma, confirmed the laws of England as he found them, reorganized the country in several great earldoms, became a Christian, and turned his way of life towards that of the more civilized centres of Europe. In 1018 the death of his elder brother Harald made him king also of Denmark. His success as ruler of the two countries enabled him safely to leave them in 1027 to make a journey to Rome. In 1028 he led Englishmen and Danes to attack Norway, where Olaf Tryggvason was king. Olaf—another convert from heathenism, later to be known as Saint Olaf—fell in battle, and Canute added Norway to what was now an imposing empire of the north. Its unity, however, depended on himself, and it fell apart on his death in 1035.

A well-known legend tells how on the seashore Canute rebuked the flattery of his courtiers by proving to them that the tide would not halt at his command ; but it is unlikely that Canute's friends and advisers included men foolish enough to invite a rebuke of that kind.

Cape of Good Hope. A well-known Portuguese navigator, Bartholomew Diaz, returned from a voyage in 1488 during which he had reached and rounded the southernmost point of the African continent. He presented to the King of Portugal a map on which this cape was named the Cape of Storms (Cabo Tormentoso), because of the gales he had encountered there. " Let us rather call it the Cape of Good Hope," said the king ; and so it is called to this day.

Nine years later Vasco da Gama, following in his track, rounded the Cape, crept up the east coast of Africa as far as (modern) Malindi in Kenya, and then sailed eastwards to India. Thenceforth the Atlantic, instead of the Mediterranean, became the chief highway of the world's commerce ; and the Cape of Good Hope acquired great importance as the half-way point in the sea route from Europe to India and the East.

The Province of the Cape of Good Hope (formerly Cape Colony), in the Union of South Africa, covers an area of 277,113 square miles. It includes the Colony proper, East Griqualand, Tembuland, Walvis Bay, Pondoland, and Bechuanaland. Sheep-rearing (especially for wool), dairying, fruit-growing, wine-making, and ostrich-farming are carried on. Minerals are found, the chief output being diamonds from the Kimberley district. There are coalmines around Stormberg, and copper ore is plentiful in Namaqualand. The population in 1956 was estimated to be 4,804,000, of whom 999,000 were white.

Capercaillie (pron. kā′perkālē). *See* Grouse.

Cape Town, South Africa. With one of the finest sites in the world, between a flat-topped mountain and a wide bay where the Atlantic surf thunders, Cape Town is called the Mother City of South Africa.

It is situated at the southern end of Africa's

T. J. McNally

AIR VIEW OF CAPE TOWN, BETWEEN TABLE MOUNTAIN AND THE OCEAN

Overlooking Cape Town is flat-topped Table Mountain, the summit of which is often obscured by a cloud called the "Tablecloth." The ridge on the right, extending down towards the harbour, is the Lion's Head. Cape Town, chief city of Cape Province, is the oldest settlement in South Africa, having been founded by the Dutch in 1652.

South African Govt.

CITY HALL IN DARLING STREET, CAPE TOWN

One of the turnings off Adderley Street, Cape Town's principal thoroughfare, is Darling Street, in which is the City Hall, built in the style of the Italian Renaissance (left foreground). Opposite the city hall is an open space called the Grand Parade, close to which is the Castle, a star-shaped fort begun in 1666. Adderley Street, which runs from Heerengracht to Government Avenue, takes its name from C. B. Adderley, a member of the British Parliament, who in 1849 successfully resisted a proposal to make the Cape a convict settlement.

west coast, where a point of land, about 35 miles long and shaped like a long-toed medieval shoe, thrusts southwards into the ocean. This point is the Cape Peninsula, and at its toe is the Cape of Good Hope. Cape Town lies just above the heel.

This city is the parliamentary capital of the Union of South Africa (Pretoria being the administrative capital), and the Union Parliament sits here from January to June. It is also capital of the Province of the Cape of Good Hope. The oldest white settlement in South Africa, it was founded on April 6, 1652, when three ships of the Dutch East India Company landed a party there, under Jan van Riebeeck, to establish a port where vessels could take in water and stores on their way from Holland to India and Java.

The chief relic of those days is the castle, close to the old waterfront. It was built 1666–1680 and, in plan, is a five-pointed star typical of 17th-century fortification. The main gate, of blue-grey stone, is on the side facing the city and copied from a town gateway of Dordrecht, Holland. Next to the castle, which is the oldest building in South Africa, is the Parade Ground, about 400 yards long, scene of many historic occasions and still gay with colour twice a week when fruit stalls are set up at one end. Otherwise the space is now used as a car park. The main railway station is immediately in front, its lines almost touching two of the castle bastions. Between here and the great harbour 200 acres were reclaimed from the bay when the Duncan dock was constructed.

The waterfront is now protected by a breakwater 3,640 feet long. There are nearly 25,000 feet of quays, and the second longest graving dock in the world. From the waterfront there runs inward through the heart of the city, towards the great curving cliff of Table Mountain, a broad highway called in different sections Heerengracht, Adderley Street, and Government Avenue, lined with handsome shops and fine public buildings. All the city's other most important streets either cross this thoroughfare at right angles or are exactly parallel to it. But everything is dominated by the huge presence of the mountain, the flat summit of which is often covered by a "tablecloth" of white cloud. From Adderley Street an aerial cableway can swing you up to the top of the mountain in half an hour. On Government Avenue stand the Houses of Parliament, facing the magnificent Botanical Gardens.

Cape Town is becoming a city of tall concrete buildings but has tried to preserve a few, at least, of the fine old Dutch colonial-style buildings which used to give it such a characteristic air. The Dutch Reformed Church, the oldest place of public worship in South Africa, still has its original clock-tower, of 1699, with the clock brought from Holland. The Lutheran Church in Strand Street dates from 1780, and next door is the fine old

house of Martin Melck, the German settler who built it. Another very fine example of this architecture is the Koopmans-de Wet House, now a museum, with slave quarters and furnishings to show how the old-style Cape-Towner lived.

The suburbs of the city have spread right round the back of Table Mountain and along the Cape peninsula with a chain of good bathing beeches. On the slopes of Table Mountain are the National Botanical Gardens, covering about 400 acres, and Van Riebeeck Park, of 240 acres, opened in 1952 during the celebrations of the 300th anniversary of the founding of the city. Near Rondebosch, three-and-a-half miles from the city, is Groote Schuur, once the home of Cecil Rhodes (see article), who bequeathed it as the home for all prime ministers of South Africa. Not far from this is the University of Cape Town, founded 1918.

The climate of Cape Town is generally sunny, with Atlantic breezes, including the south-east wind popularly called the Cape Doctor, which blows in the summer days of January. Between November and April the temperature may exceed 100° F., but in July and August fires are needed.

Cape Town was occupied by the British for the first time during the years 1795 to 1803, but was handed back to the Dutch under the Treaty of Amiens (1802). Three years later, when Louis Bonaparte became king of Holland, the British once more took possession. The city was sold to them by the Dutch in 1814. It remained capital of Cape Colony until the Union of South Africa was constituted in 1910. Thus the streets have a mixture of English and Dutch names—Longmarket Street and Buitengracht, for instance. In Queen Victoria Street is the Huguenot Memorial, reminder of a band of these French Protestants who, having fled to Holland, were encouraged to settle at the Cape. You still find in the city such French names as de Villiers, Joubert, and Marais.

The population is about 690,000, of whom only some 275,000 are of European descent.

Cape Verde Islands (English pron. värd). If you look at a map of the Atlantic Ocean, you will see that a number of shipping routes, especially those from Europe to South America, touch the island of São Vicente (St. Vincent). Here, at Porto Grande, steamers on these long voyages refuel with coal or oil.

The island is one of the Cape Verde group, lying 350 miles off Cape Verde, on the west coast of Africa. The group consists of ten islands and several islets, all of volcanic origin. They are rocky and mountainous, hot and unhealthy for Europeans, and sometimes suffer severely from drought. Nevertheless the islanders grow many tropical crops, raise goats, cattle, pigs, and donkeys, and catch turtles off the coasts. They export coffee of very good quality, and other important products are hides, mustard, castor oil, brandy, and oranges.

Portuguese explorers discovered the Cape Verde Islands in 1441–56, and they have for centuries been a Portuguese colony. The largest and most populous of the islands is São Thiago (Santiago), where the capital, Praia, is situated. São Vicente is the commercial centre. The group has a total area of about 1,550 square miles. Two-thirds of the 150,000 inhabitants are half-caste, and most of the rest are of Negro blood. There are altogether about 3,000 Europeans settled in the islands.

Carbolic Acid. In 1865, Joseph Lister carried out, at Glasgow Royal Infirmary, the first surgical operation in which an antiseptic was used to prevent bacteria from infecting the wound. This operation revolutionised surgery, as until that time scores of patients had survived serious operations but had later died when their wounds turned septic. The antiseptic used by Lister (see article) was carbolic acid.

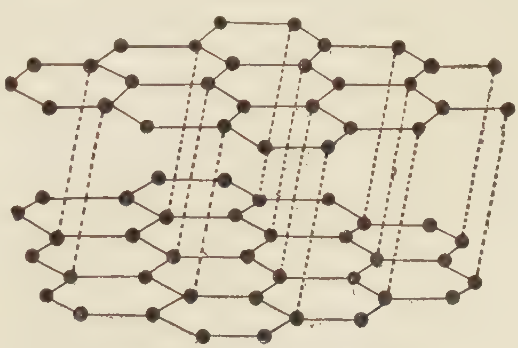
Other antiseptics have long taken the place of carbolic acid in surgery, for a strong solution tends to burn the flesh and its power to kill germs is limited—some, indeed, thrive on it. To-day, however, certain popular home disinfectants of the "Dettol" type are based on a close relative of carbolic acid, reinforced by chlorine atoms.

In industry the acid is called phenol. It is either extracted from coal-tar or produced synthetically from benzene. Large quantities are used in making dyestuffs, explosives, and the phenol-formaldehyde plastics, usually called "Bakelite."

Carbon. The hardest known substance, the diamond, and the only solid so soft that it can be used by itself as a lubricant, graphite, have one thing in common. They are both pure forms of the most versatile of all the elements, carbon. The difference lies in the arrangement of the atoms. In the diamond each atom is interlocked with four others into an almost unbreakable whole. The carbon atoms in graphite, however, are arranged in layers, which can easily be rubbed off, as happens when the graphite "lead" of a pencil touches paper.

Both diamonds and graphite are mineral, or inorganic, substances, derived—like salt, soda, sulphuric acid, and many others—directly or indirectly from the inanimate material of the earth's crust. But there is another important class of substances known as organic chemicals, originally so called because they were derived from living organisms. This class includes the natural textile fibres like wool and cotton ; certain natural drugs such as quinine ; acids of vegetable origin like citric acid ; natural plastics like rubber ; fats and oils ; and so on. All the substances in this vast and varied range have one common characteristic : they all contain carbon.

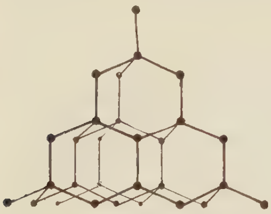
Carbon lies at the very centre of life. It is quite



CARBON ATOMS IN GRAPHITE

This diagram shows the arrangement of the atomic nuclei in a crystal of graphite. Only half the nuclei in the lower layer are directly under those above ; the rest lie under spaces. They are arranged in hexagonal (six-sided) figures.

the most remarkable of all the 92 natural elements. To a degree quite unknown in any of the others, it can combine freely with itself. Atoms of carbon can form long chains, branched or straight, as well as large and small rings or combinations of rings. It can join with a great variety of other elements, too, such as nitrogen, hydrogen, oxygen, sulphur, chlorine, bromine, and iodine. Because of this there are literally hundreds of thousands of carbon compounds. The study of them demands the attention of specialists, who can discover the exact pattern of the carbon and other atoms in all but the most complex organic materials, and who can foretell the likely properties of a substance containing any given combination of atoms. It is to the research of these people, especially during the last century, that the world owes the vast range of substances containing carbon—including dyes, detergents (chemical cleaners), plastics, drugs, insecticides, weed-killers, photographic developers, and synthetic fibres—which are not known in nature at all, and have done so much to improve modern life.



DIAMOND
In a complete crystal this pattern of nuclei is repeated in all directions.

To manufacture organic chemicals, industry needs raw materials rich in carbon. In practice this usually means either coal, containing about 75 per cent. (by weight) of carbon, or petroleum, which contains rather more. The carbon in coal becomes available to the chemist as coal-tar, a by-product of the making of coal-gas. When purified, coal-tar yields a variety of products, the most important being benzene. Coal-tar also contains about 10 per cent. (by weight) of a white solid called naphthalene, extremely important in the manufacture of dyes. Other valuable compounds are anthracene and toluene, used in making many things, from the explosive called T.N.T. to saccharine. These coal-tar chemicals and those derived from petroleum, are compounds of hydrogen and carbon ; hence their name, hydrocarbons. By certain basic processes, simple to describe but complicated to carry out, they can be converted to the many synthetic organic chemicals. The oxidisation of naphthalene produces phthalic anhydride, valuable in the manufacture of paints and dyes. Benzene treated with nitric acid, mixed with oleum, forms nitrobenzene, which is easily converted to aniline. Chlorine also combines easily with the hydrocarbons, and one result is the insecticide called " Gammexane." If ethylene, another hydrocarbon now made in Great Britain from petroleum, is subjected to immense pressure in special vessels, it forms polythene. The same gas is used in the manufacture of " Terylene," the detergent " Stergene," and anti-freeze preparations. Another important group of carbon compounds are the alcohols (*See* ALCOHOL.)

But the most important fact about carbon is that our bodily energy is obtained by " burning " to carbon dioxide the carbon contained in every kind of food we eat. The cheapest foods from the point of view of producing energy are those which contain carbohydrates — sugar is an example. Carbohydrates are compounds of carbon, hydrogen, and oxygen, in which the last two elements are in the same proportions as in water, that is, twice as much hydrogen as oxygen. Starchy foods—potatoes, root crops, wheat—are also very complicated carbohydrates. They are broken down into forms usable by our bodies by the action of various enzymes (see article) or by natural catalysts. Fats, proteins, and vitamins all contain carbon, although the processes by which the human body converts them to its own use are only now being understood.

Carbon Dioxide. Men, like all the animals, breathe in air, take oxygen from it, and breathe out carbon dioxide (CO_2) Both this process and that of burning would soon exhaust the oxygen in the air, were it not for the fact that living green plants take in the carbon dioxide and release oxygen (*see* PHOTOSYNTHESIS). Thus the balance of the atmosphere is maintained.

Carbon dioxide, a gas with no colour and little smell, and one-and-a-half times as heavy as air, is produced in great quantities as a by-product of the fixing of nitrogen by the Haber-Bosch process (*see* AMMONIA). It is also formed in lime burning, in many fermentation processes, and in other ways. Although much of it is allowed to go to waste, that which is saved is put to many uses. When compressed, it liquefies at ordinary temperatures, and if suddenly released, it expands and solidifies. In this solid form—known as dry " ice " or " Drikold" —carbon dioxide is widely used as a refrigerant, particularly in the transport of perishable foods. Unlike ice, it does not melt to form a liquid but simply turns into a gas which escapes into the surrounding air.

A great deal of carbon dioxide is used for the manufacture of soda-water and other " fizzy " drinks, a use originally proposed by the 18th-century scientist Joseph Priestley. Carbon dioxide is also used in fire-fighting when, as in oil and petrol fires, water is unsuitable. Being a heavy gas, it blankets the flames and prevents oxygen from reaching them. Water or foam extinguishers make use of carbon dioxide as a propellant. In older types of extinguisher the gas is formed by the action of sulphuric acid on bicarbonate of soda. In the newer type, liquid carbon dioxide under pressure is used ; these extinguishers can be turned off when the fire is out.

Carbon Monoxide. If coke is burnt in insufficient air, producer gas, a mixture of carbon monoxide (CO) and nitrogen, is made. This gas is used in gasworks for heating the retorts, but because the nitrogen does not burn, it has not enough heating power for the domestic supply. A more powerful fuel, which is released by the gasworks when demand is at its height, is water gas, a mixture of carbon monoxide and hydrogen made by passing steam over red-hot coke. A combination of hydrogen and carbon monoxide under pressure, in the presence of a catalyst, forms the important industrial substance called methyl alcohol. (*See* ALCOHOL.)

Carbon monoxide is poisonous. This is the gas which kills people who put their heads into unlit gas ovens, or breathe exhaust fumes from a car in unventilated places.


Aerofilms, Ltd.

CARDIFF'S CITY CENTRE IN CATHAYS PARK

In 1955 Cardiff became the capital of Wales, but for many years it had been the leading city of the Principality, with many fine public buildings. In Cathays Park, 59 acres, is an impressive civic centre arranged round a central garden. The City Hall, centre foreground, was completed in 1904. It has a dome surmounted by a Welsh dragon. and a tower 200 feet high. Among other structures in this dignified scheme are the Law Courts, the National Museum of Wales, and the University College of South Wales and Monmouthshire.

Cardiff. It was only in 1955 that Cardiff became the capital of Wales, although for years it had been the chief city. Until then there was no official Welsh capital. The largest town and the principal seaport of Wales, near the mouth of the river Taff on the Severn estuary, Cardiff (Caerdydd to Welsh speakers) ranks among the largest ports of the British Isles, its prosperity arising from its being near the coalfields and industrial areas of South Wales. It is the county town of Glamorganshire. The city includes Llandaff, where the cathedral was heavily bombed in 1941, but later restored.

The harbour is tidal, and the docks extend over some 200 acres. Its importance began with the opening of the canal from Merthyr Tydfil in 1794; but Cardiff had to wait 40 years for its first dock.

In Cathays Park, once a part of the castle grounds, are Cardiff's finest public buildings. The chief of them is the City Hall, a Renaissance-style building with a clock-tower 200 feet high. The National Museum, opened by King George V in 1927, contains a collection illustrating the geology, natural history, and archaeology of Wales. Other buildings in Cathays Park are the Law Courts and the University College, which, with those of Aberystwyth, Bangor, and Swansea, forms the University of Wales. Cardiff's largest public park is Roath Park, with a lake for boating and bathing. The population in 1951 was 243,627.

The history of Cardiff goes back to a Roman fort, which formed the foundations of a castle built in the 12th century by Robert Fitz Hamon, a relative of William the Conqueror, who went to live there in 1091. It was from the castle that the present city acquired its name—Caer-Taff, the castle or fort on the river Taff. Containing a number of fine apartments, the castle was presented to the city by the Marquess of Bute in 1947.

Cardiff was often attacked by the Welsh during the Middle Ages and captured by them for short periods in 1158 and 1404, before the union of England and Wales. It supplied the Spanish Armada with guns; it was made a borough in 1608 by James I; and it was Royalist in the Civil War. It was raised to the rank of city in 1905.

Cardiganshire. This large crescent-shaped Welsh county faces Cardigan Bay and consists of rolling hills stretching to the Plynlimmon Range, east, and Elenith Hills, south.

The most important place in Cardiganshire (Welsh, Sir Aberteifi) is Aberystwyth, on the coast in the north of the county, a town numbering 9,323 people in 1951. This is a health resort and the chief centre of Welsh culture, being the headquarters of the University College of Wales, founded in 1872, and a constituent college of the University of Wales. Here also is the National Library of Wales, which contains the world's finest collection of Welsh books and manuscripts and is one of the six libraries receiving a copy of every book published in the United Kingdom. Edward VII granted its charter in 1907. Aberayron and New Quay, midway along the coast, now holiday resorts, were once small ports. Cardigan (1951 population

3,497), the county town at the mouth of the river Teifi, lies at the extreme south-west of the county and is a market centre. Borth, in the north of Cardiganshire, and Llangranog, between New Quay and Cardigan, are small seaside resorts which have become very popular since 1945. The river Teifi forms the southern boundary of Cardiganshire. On it are Llandyssul, Lampeter, and Tregaron. At Lampeter is St. David's College, which has university status and grants its own degrees in arts and theology. Between the coast and the Teifi the Mynydd Bach hills rise to 1,129 feet, and to the north-east is Plynlimmon (2,468 feet). On the river Rheidol stands Devil's Bridge, a famous beauty spot. Agriculture and stock-raising, helped by a mild winter climate, are the chief industries; lead, copper, slate, and zinc are also worked. The area of the county is 692 square miles and its population in 1951 was 53,267.

Cards, Playing. The ordinary pack of 52 playing cards has a much longer history than most of the common objects to be found in our homes. Its origin is lost in antiquity, but it seems probable that cards were invented in the East and brought to Europe by the wandering Gypsies. In the same form as they are known to-day, cards existed in the 14th century, and they were among the first things to be printed from engraved blocks. The first printed Bible followed a few years after the first printed playing cards! But long before this, packs of cards, hand-painted and very valuable, had been in use, though not for playing games but for telling fortunes. These were the Tarot or Tarocchi cards, numbering altogether 78 in a pack, but comprising two distinct sets, one of 22 and one of 56. The 22 were used solely for fortune-telling, one of them being the Fool, which, like the Joker to-day, had power over all the others; he represented good fortune when he occurred with a good card, and bad luck with a bad card. The Fool, with his power over other cards, perhaps survives to-day in many games as the Ace, which, though having the smallest value of all, is stronger even than the King. The 22 Tarot cards were variously designed and did not form suits, but the 56 were divided into four suits marked with distinctive symbols for the four most important social classes—the Cup, which is said to represent the priests; the Sword, representing warriors; the Piece of Money (merchants); and the Club (farmers).

These symbols have changed form many times, and differently in different countries. The Cup has become the Heart of the modern pack, the Sword has been shortened and broadened into the Spade, the Piece of Money is now a Diamond, and the Club (which was often shown as a sprouting branch) gives its name to a clover-leaf-shaped design. The old cups, money, swords, and clubs are still used in Italian, Spanish, and Portuguese packs; the German pack was originally hearts, bells, leaves, and acorns; the French pack of hearts, diamonds, spades, and clubs was adopted in England. As an example of how muddled the English pack has become, the spade design resembles the German leaf but its name is the Italian word (*spada*) for sword; the club design resembles the German acorn, yet the acorn is just as likely to be a form of the heart shape. In French, heart is as in English, *cœur*; but the diamond is *carreau* (square), the spade *pique* (pike), and the club *trèfle* (clover). It is almost impossible to sort out the tangle of shapes and names which is the modern pack. The figures of the court cards were in the distant past often caricatures of well-known people. The standard court cards in the modern English pack have been the same since Henry VIII and are dressed in the costumes of his day.

The original 22 fortune-telling Tarot cards disappeared from the pack when cards began to be used for playing games, and the 56 were reduced to 52 by abolishing one of the old court cards. These had been king, queen, knight, and valet; the knight was left out and the modern king, queen, and jack (or knave) remained. The reason for this reduction in numbers is not known for certain. It is worth noticing that there are 52 weeks in the year, divided into four seasons, and this may have had some influence; more probably it was found necessary to have an odd number of cards in each hand of a four-handed game, as otherwise there would be the possibility of frequent ties or draws.

One theory of the origin of cards is that they are connected with chess (see article), another game of Eastern origin, also with the classes of society (kings and queens, bishops, knights, and the pawns). Chess may once have been played with cards, and it is believed that in both cards and chess the queen was a Western invention, replacing an earlier vizier (or prime minister) on the board and in the pack. Further, chessmen, now usually white and black, were formerly commonly white and red, and sometimes red and black, as still often seen in small sets.

Above, from Sir Gurney Benham's Playing Cards: Ward Lock & Co.

CARD KINGS — OLD AND NEW

The court cards of the modern English pack are derived from those produced by Pierre Maréchal at Rouen, in France, about the year 1567. On the left is his King of Spades, and on the right the present-day King of Hearts.

CAREERS: CHOOSING YOUR LIFE'S WORK

Careers. The choosing of a future career is for most people the first really important decision they have to consider. Unfortunately it usually has to be made in one's 'teens, when, because of youth and inexperience, young men and women can have only a very limited and somewhat vague idea of what they are letting themselves in for. One thing, however, is clear—the decision will have tremendous influence on their future lives, and therefore should demand respect and some very careful thought.

Despite this obvious line of reasoning, some boys and girls still persist in taking the dangerously easy path of choosing their first employment on early local impressions, or on hearsay, or on what a friend or relation has done, or even of drifting—without making any attempt at selection at all—into the most convenient and well-paid job which happens to be advertised at the time they leave school. Occasionally, and more by good luck than good management, this method turns out to be successful, or reasonably so. More often than not, however, it proves to be a false start which, if not remedied in good time, leads to disillusionment and sometimes even to serious unhappiness.

There is a world of difference, therefore, between this mere " finding of a job " and the deliberate choosing and planning of a career. Admittedly the latter step is not easy. It demands some effort, some thought, some patience, also a willingness to seek information and to listen to advice from older people; not that the advice must be taken, but the information gleaned and some of the " tips " received will amply repay the trouble and, like clues in a detective story, eventually contribute to a solution.

Not everybody can find the perfect vocation; and although much has been said and written about square pegs in round holes and round pegs in square holes, it is best to remember that there are as many differently shaped pegs as there are human beings, and as many differently shaped holes as there are occupations. The great majority of people have to whittle off a bit here and there in order to adjust themselves to the particular demands of their chosen work; but the necessity for this whittling down can be kept to a minimum. Mistakes which lead to the wrong choice of career can certainly be avoided.

Satisfaction in Work

A well-chosen career generally brings in its train skill, responsibility, and due rewards. It is also likely to give what is perhaps of more importance—real satisfaction in work. As Mark Twain pointed out in *The Adventures of Tom Sawyer*, it is not so much what we do but whether we want to do it or not which really matters.

From this it might seem that all that has to be done is to find out just what you do want to do and, hey presto! the solution is yours. But what one wants to do and what one is *fitted* to do are sometimes very different things. Nevertheless there are such personal qualities as determination and ambition, both powerful driving forces which enable people to reach their goals and do what they really want to do, even if at first they do not promise to match up to the requirements and the obstacles appear insurmountable. While one is still at school it is impossible to forecast these things. It is a decided advantage, therefore, to know at the outset exactly what the obstacles are.

The time to start thinking of the type of work for which one is best suited will obviously differ according to individual circumstances, but it should certainly be early enough to allow for a gradual approach, rather than a last-minute one. Parents will most probably start to think seriously about it long before the child—perhaps when the child is about 11 years old and is transferred from a junior to a secondary school. The kind of school for which he is then selected is chiefly of educational importance, but in all probability it will also raise in very general terms first thoughts about future fields of work.

When to Choose a Career

Further thoughts may well arise at the age of 13 or so, when perhaps a choice has to be made between " arts " subjects and the sciences. Here again the selection is of educational importance, but there is also a *vocational* significance in the dropping of or the " opting for " certain subjects in preparation for the General Certificate of Education examination.

By the time the child has reached the age of 14½, the question should certainly be of more than general interest. The time to get down to detail, however, obviously depends on the age at which he or she is likely to leave school. The longer full-time education lasts, the more time there is in hand. A university student, for instance, can —and indeed should—defer his final choice until comparatively later on in his course; after all, a university education is not a vocational training.

Although in making up your mind it is tempting to think first of the various careers about which you have heard or read, the best plan is to begin by thinking of yourself. On the face of it, this may appear selfish; but little progress can be made until you do appreciate the main differences that distinguish one person from another and which of these characteristics apply to you as an individual.

It is evident, for instance, that some people are what can broadly be termed " practical." They are scientifically-minded, or they have a technical ability in the handling and understanding of things like machinery and apparatus of all descriptions. They are the people who like to produce, make, and repair. They can generally use tools dexterously, and have a ready insight into the mechanical working of moving parts, and see with ease how the action works and fits together.

On the other hand, some people are not noted for being handymen. They may well work best

with words or figures, in some academic, administrative, or clerical setting. These will find an appeal in working with abstract ideas—initiating, executing, recording, or transmitting them to others either verbally or on paper.

Yet again, others can be said to have a strong social sense, and are interested chiefly in people, their problems and their needs. They have the knack of getting on well with others and generally feel, sometimes quite strongly, that they can find their true vocation only in working with, and on behalf of, their fellows.

Some others have a pronounced appreciation of things artistic, perhaps of music or of the differences and combinations of light and shade, form, and colour. If linked with a practical ability in performance, these people are said to possess an artistic aptitude.

Personal Inclination

These varied characteristics—the practical, the abstract, the social, and the artistic—exist in all people to some extent, but they are never equally balanced, nor can they ever be looked upon as being confined in separate watertight compartments. Usually there is in each person a recognizable degree of bias towards one of them, or a combination of two of them. To recognize this inclination or bias in yourself is the first step towards making a wise choice.

As already noted, each occupation makes its own particular demands on those who seek to make it their career. Before considering these demands in detail, it is a good plan to have a look at the field of careers in general and see how they, too, group themselves according to *their* main requirements.

As with the human characteristics outlined in the previous paragraphs, it is impossible to fit each career and occupation into a watertight compartment bearing one, and one only, of the four labels —practical, abstract, social, and artistic. Even so, most of them do make a special call for one or another of these personal inclinations.

Some occupations are concerned *chiefly* with things scientific, technical, mechanical, or practical. Such is the work of applied scientists, technologists, technicians, craftsmen, and machine operatives. This does not mean that the supervisor in a large engineering concern need not possess an ability for the successful handling of people, or that the scientist and technologist have no need of an ability for initiating ideas or using words to transmit those ideas to others, or that practical people are not the stuff out of which good administrators are made ; but before succeeding at those levels in their work, and particularly when choosing and making their early way in their jobs, they must have had the *practical* aptitude clearly uppermost.

Although to-day emphasis is laid upon technical development, and the word " industry " generally conjures up mental pictures of power stations, coal mines, shipyards, engineering workshops, and building construction, the basic industry of agriculture also continues to appeal to, and to employ, practical people whose concern is with live (as opposed to inanimate) things. The farmer, the agricultural scientist and adviser, the veterinary surgeon, herdsman, stockman, farm-worker, horticulturalist, forester, and market gardener are all examples of practical specialists working at different levels in this particular sphere.

A second large group of occupations embraces those concerned chiefly with people—observing, interviewing, advising, informing, serving, and controlling. Here the main requirements are patience, sympathy, a genuine interest in other people, and a readiness to appreciate their problems. Such are the jobs of the doctor, dentist, and nurse ; the salesman and saleswoman, policeman and policewoman ; the receptionist, waiter, steward and stewardess ; the welfare officer, personnel officer, public relations officer ; the minister of religion and probation officer. Sometimes the work concerns children or young people—as with the nursery nurse, the children's officer, or the teacher, the youth club leader, and the youth employment officer. Often the task is to guide and control people at work—as with the foreman, supervisor, and manager.

Before all these people can begin to work for and on behalf of others, they have to acquire some specialised knowledge and skill. Sometimes this training has to be of a scientific or technical kind —as with the doctor, dentist, or nurse—and it is in such instances that one can recognize the merging together of two career groupings and the impossibility of defining them too closely.

The third group, labelled for the sake of brevity " abstract," includes all those occupations which call for an academic ability for research and original thought, or for a ready aptitude with the use of words or figures. Skill with these is a great asset in most occupations, but it is a prime necessity in those which come within this group. Words, whether written or spoken, are the main means for the transmission and sharing of ideas. Verbal ability is vital for the law, for most kinds of salesmanship, teaching, church work, and politics. Ability to write well is similarly vital for any headway to be made in journalism or authorship of any kind, copywriting for advertisements, and all administrative and organizing work.

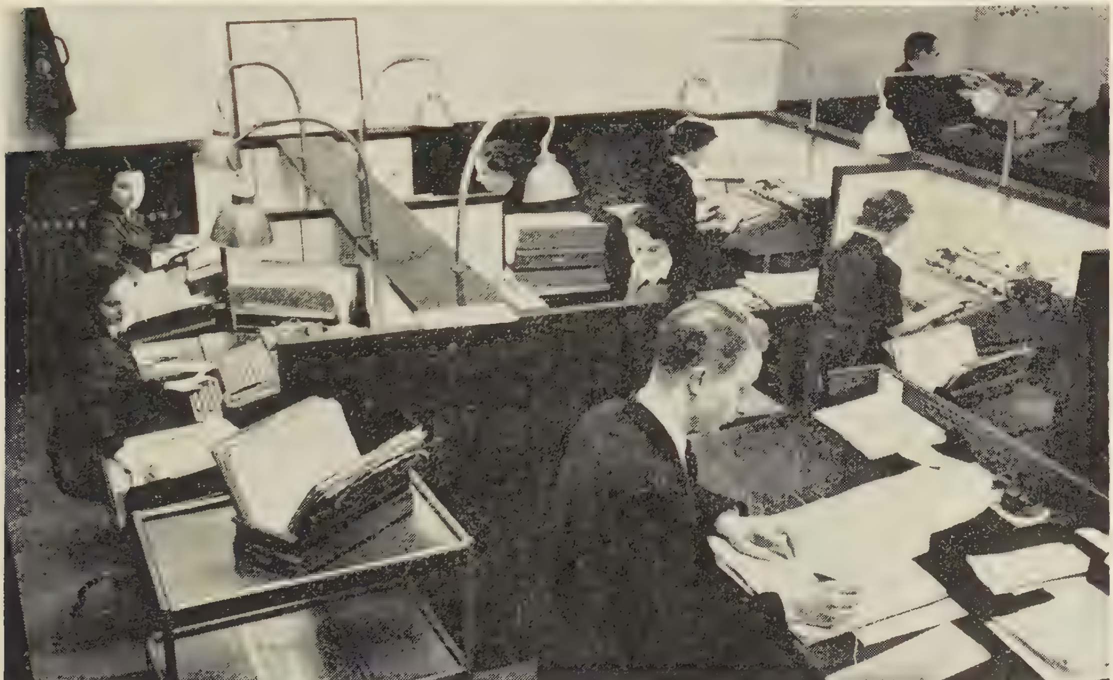
Importance of Records

In all branches of the professions, as in commerce and industry, records have to be maintained of people and of their work, their plans, and their activities ; of the materials they need and use ; and of the money they utilise to purchase these materials and to further their activities. Such records range from the great registers of births, deaths, and marriages at Somerset House, the ledgers in the banks, the files of the ministry of labour and national service or the ministry of national insurance, and of the post office, etc., to the account books kept at the local shop. Every company keeps records, and each year the secretary has to send details to the Registrar of Companies. Every business concern has to keep accounts in order to satisfy the taxing, customs, and excise authorities ; and details of staff salaries, wages, and deductions must be recorded every week, month, or quarter. Many of the occupations within this group obviously require some skill with figures, *e.g.*, the work of the accountant, banker, actuary, and book-keeper.

CAREERS WITH WIDELY DIFFERING APPEALS

J. Lyons & Co., Ltd

More and more girls are applying for admission to dental schools (left), where they receive four years' training. Skill with the hands, an equable temperament, and good eyesight and general health are essential requirements. In addition to dentistry, students are required to take a number of medical subjects. There is a continuous demand for experienced confectioners, whose skill is fully revealed in the decoration of wedding cakes, seen right.



The Times

Scope for employment in banking varies with the type of bank, but there are opportunities for both men and women, who must have received at least a good secondary education. Banks use many kinds of accounting and tabulating machines, and most of the operators are women, as can be seen in the photograph. Some banks have their own training schools, and employees are encouraged to study for the examinations of the Institute of Bankers.

This group also includes the occupations of clerk, secretary, and shorthand-typist. Although a big reduction in the number of such workers is not foreseen in the immediate future, an increasing amount of office work is now being done with the aid of machines. This is particularly so with figure work. The use of computors, adding machines, and other "electronic brains" will gradually mean fewer clerical opportunities for people with this inclination. On the other hand, the introduction of the machine is in its turn creating different opportunities and new sorts of occupations.

Artistic Careers

The fourth group of careers—the artistic—embraces all branches of creative design and advertising and display work, as well as the fine arts of drawing, painting, sculpture, etching, etc. This aptitude in varying degrees is also demanded of those taking up work in the field of "applied" art, *i.e.*, where the need for some appreciation of light and shade, colour or form, merges into the other groups of career requirements. Photography, for instance, may be termed a technical art, demanding a combination of the practical with the artistic. Architecture, despite its call for a practical outlook and specialised technical knowledge, is primarily a creative art, and the balance between the artistic, the abstract, and the practical in an architect's make-up is vitally important.

To be even reasonably successful in a career in the fine arts you have to measure up to an exceedingly high standard. Genuine talent, backed by determination and a devoted sense of vocation (*i.e.* a feeling that this is what you were really born for) is essential, and if you have it, the choosing of your career is no great problem. The same can be said about careers in music, the ballet, and the drama. Many people who do not aspire to the professional standards required for performing find their vocation in *teaching* their art. Many more turn for their livelihood to alternative careers, matching other inclinations or abilities, retaining their artistic gifts as a lifelong hobby on an amateur basis. These, also, are fortunate, because such hobbies can be wonderful antidotes to the stress and strain of contemporary life.

This grouping of occupations is admittedly rough and ready, but it does provide one useful method of breaking down the very wide range of occupations into sections sizeable enough for piecemeal consideration. No doubt the brief descriptions of each group will have prompted some preliminary ideas. That stage having been reached, it is now necessary to turn from generalities to detail.

A list of occupations is provided on pages 242–44. This is based on the four main groupings, together with brief notes on the scope available. This list has not been compiled in any order of priority, and it is not exhaustive. It should be found adequate for the more detailed consideration you now have in hand, and it is suggested that on the basis of this list you draw up a shorter list of those careers which interest you and at the same time seem to come within the range of your particular capabilities.

The next task is to narrow it still further by finding out the detailed requirements of each career in the list. Basing your choice of future employment on faulty or incomplete information is dangerous, *and it cannot be too strongly emphasised* that full and accurate information on careers must be methodically sought and checked before any decision is made.

There is certainly no lack of literature containing this sort of information. In fact, you may even find yourself bewildered by its profusion. An extremely useful Readers' Guide (No. 31 : Choice of Careers), issued by the Library Association, goes a long way to meet this need. It lists virtually all the books on careers now in print, and it can be consulted at any public library or youth employment office.

Many of the books so listed are to be found in most school libraries, particularly those booklets in the ministry of labour's "New Choice of Careers" series, specially prepared for the use of young people, parents, and schools by the Central Youth Employment Executive in consultation with the ministry of education and the Scottish education department. In 1957 this series consisted of some 80 separate booklets, and five or six new ones are added each year. The ministry is also responsible for the publication of the "Careers for Men and Women" series of booklets, also for the periodical issue of a summary of much of this information, called *Careers Guide—Opportunities in the Professions and in Business Management.*

Several publishing firms have contributed similar guides and dictionaries of careers to this ever-growing library. A *Careers Encyclopaedia*, edited by G. H. Chaffe, is probably the most nearly comprehensive. It covers over 200 careers, and it includes useful suggestions for further reading under each heading. In 1957 appeared the first issue of *The Year Book of Technical Education and Careers in Industry*, edited by H. C. Dent. The University of London Appointments Board and the British Federation of University Women, Ltd. have also issued useful reference books, that of the former being *Careers for Graduates* and that of the latter, an up-to-date survey called *Opportunities for Girls and Women in Science and Technology*. Some newspapers, both national and provincial, regularly publish careers supplements.

Other Useful Publications

During recent years there has also been a considerable output of literature on careers from individual firms, employers' associations, professional bodies, the Civil Service, the nationalised industries, the armed forces, and so on. These publications are *not* listed in the Library Association's Readers' Guide, but can be consulted at any youth employment office or obtained directly by writing to the professional organization or firm concerned.

From whatever source the information is obtained, the essentials to look for remain the same.

1. *A description of the work* involved and some general information about its background.

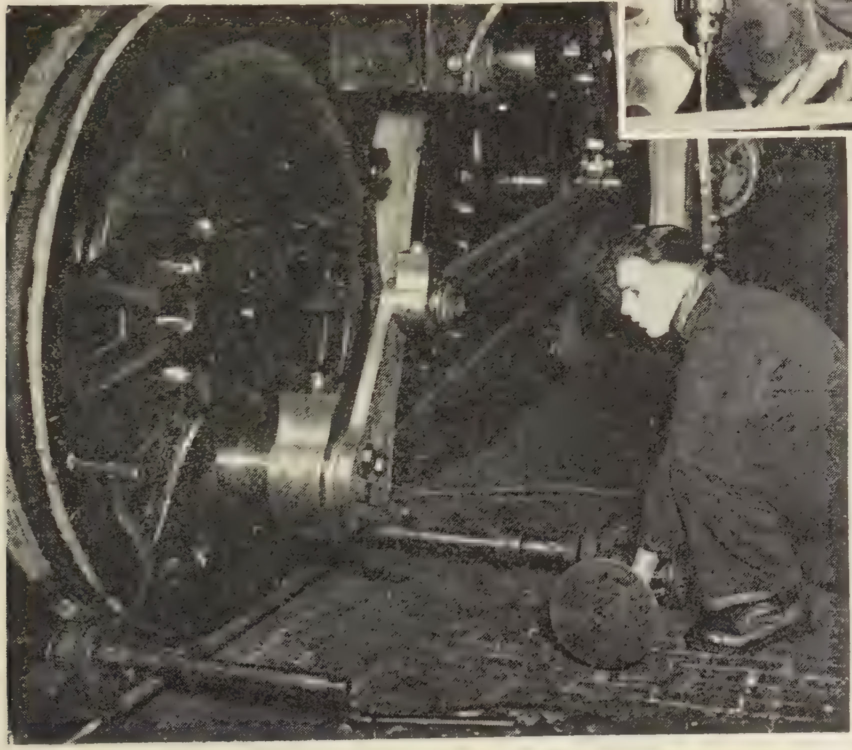
2. *The inclination and temperament needed.* You should try to gauge the personal qualities

SOME OF THE VARIED OPENINGS IN ENGINEERING

Boys interested in construction, with a gift for improvisation, and reasonable ability in mathematics, can be assisted to become civil engineers by scholarships and several schemes whereby they earn as they learn. But the best early training for a career which demands the brains to conceive a construction plan and the powers of leadership necessary to carry it out, is based on as broad a general education as possible. In the left-hand picture civil engineers study a plan on the site.

Institution of Civil Engineers

The apprentice under practical instruction in a workshop of the Atomic Energy Research Establishment at Harwell, Berkshire, has entered a comparatively new branch of engineering, and one that demands the highest qualifications.



British Railways operate a training scheme, and the apprentice in the left-hand picture is setting the valves and driving wheels of a locomotive as part of his advanced practical training.

U.K. Atomic Energy Authority; British Railways

required for the work and confirm whether your preliminary matching ideas were on the right lines.

3. *Physical requirements.* You should find out whether the work is unduly strenuous or will make any other particular calls on your health and stamina. Some boys and girls need active outdoor work; others may need a more sedentary, indoor type of job. Poor eyesight or hearing, or some physical disability, may prove to be a disadvantage or even an insurmountable handicap in some occupations. Others may call for a good head for heights; some cannot be carried out at all if a person is deficient in the perception of colour; others may call for good bearing and speech and a smart appearance. Usually these physical points prove to be negative factors in the choice of a career, in that they indicate what should be *avoided*, at least, even if not what should be chosen.

Standards to be Reached

4. *Educational requirements.* Most professional bodies, and the Civil Service and similar employing authorities, as well as individual firms in industry and commerce, have adopted the General Certificate of Education as a yardstick for measuring the suitability of applicants for some appointments. These pre-entry requirements differ in detail, but are generally defined in terms of so-called Ordinary and/or Advanced level passes in a number of subjects, some of which are specifically named. Sometimes these requirements are rigid, but mostly they are reasonably flexible in application, a great deal depending on individual circumstances. It is worth bearing in mind that although the requirements may not actually debar someone who does not possess them from obtaining a post in that occupation (if he or she is otherwise suitable), the standards laid down have to be reached sooner or later, and other professional examinations passed, before any worth-while advancement can be achieved. A boy or girl who is not academically inclined, and who does not succeed with examinations like those leading to the General Certificate, would therefore be ill advised to consider careers that demand studies and examination qualifications at that level and beyond. There is, of course, a wide range of occupations which do not present such high or well-defined requirements, and in which employers tend to seek evidence of good general education with reasonable ability in two or three subjects relevant to the type of work or training they offer, *e.g.*, for a craft apprenticeship in the engineering industry most employers look for some basic abilities in mathematics, English, and science, together with a practical manual aptitude.

5. *Ages and levels of entry.* Employing authorities have naturally adapted their schemes of recruitment to the country's system of education. As a result, there are usually four levels of entry, each broadly matched to the educational requirements of the various occupations. They are as follows:

(i) At the statutory school-leaving age of 15.

(ii) At the age of 16–17, when numbers of boys and girls leave independent and secondary schools, or other extended courses of full-time further education, many of them after acquiring General Certificate of Education qualifications at the Ordinary level.

(iii) At the age of 18–19, when others, fewer in number but more highly qualified, leave on completion of their full secondary course, and usually after taking their General Certificate of Education at the Advanced level in two or more subjects.

(iv) At the approximate ages of 21–24, when young men and women leave the universities, technical colleges, and other similar establishments, after graduating in still further advanced courses of study and specialisation.

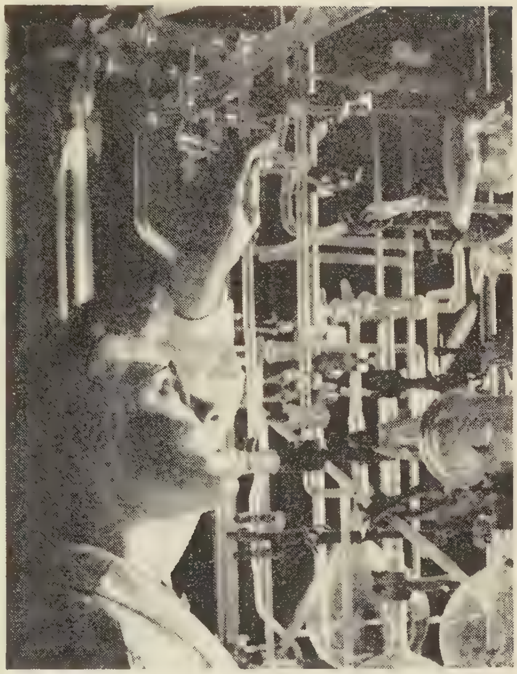
Not all employers recruit at *all* these levels, of course, but most of the larger organizations find it essential to do so in order to acquire the services of the variously qualified people they need. Some professions offer only two levels of entry, or even one, *e.g.*, an intending teacher has the choice of two, either after a specialised course at a training college or after an approved course of study and graduation at a university. A doctor, veterinary surgeon, and barrister, on the other hand, have one level of entry, and can take up their work only after reaching a stipulated qualifying level of knowledge and proficiency.

Although conditions and opportunities differ from firm to firm, the engineering industry broadly presents three levels of entry—craft apprentice, student apprentice, and graduate entry for those with specialist qualifications. In this industry and many others there is ample opportunity for progress by dint of hard work, determination, and ambition, and there is no need to regard each of these different levels of entry as leading to one level and one level only within the career chosen. Most schemes of recruitment and training have what is known as a "ladder" plan, and a transfer from one ladder or level to another is open to those who are keen and willing to study and work hard.

Test of Determination

6. *Future training.* One of the main distinguishing features between a job and a career is that the latter nearly always demands further study and the obtaining of qualifications as a prerequisite of advancement. Sometimes this training is prolonged, sometimes comparatively short. It may be undertaken voluntarily or compulsorily. It may be full-time or part-time, or by means of correspondence courses. Whichever it is, it is bound to test your determination as well as your abilities, and certainly needs to be noted as one of the most important of requirements. If you choose the career, you must be prepared to accept without question the training and study that go with it.

7. *Scholarship facilities.* The cost of undertaking courses of further study will also be of some significance, especially to parents. Scholarship facilities and other forms of aid have never been so widely available as they are to-day, and both public and private opinion tend to insist more and more that young people should be enabled, so far as is possible, to take up at the appropriate level the work for which their abilities fit them, irrespective of the financial resources of their



U.K. Atomic Energy Authority

A gown model (left picture) must have poise and perfect control of every movement, which can be acquired only by constant practice. Laboratory assistants (above) must have attained a high standard of general education. Many research chemists now of top rank began work as such assistants.

Women recruits to the police force enter as constables (policewomen), and spend three months at a training school, receiving instruction in general duties before being posted to a station. The six policewomen in this picture are being shown an area of London's dockland, which they will have to patrol. In the police force there are many opportunities for specialisation. Women police do much good work among women and children.

parents. If the cost of any course of study at a university, technical college, or other similar establishment, presents what seems to be an obstacle, it is always advisable to seek information about scholarships from your head teacher, the youth employment officer, or your local education authority.

8. *Prospects and salaries.* As already intimated, a career is also a livelihood, and it is only right that you should question prospects and likely salaries. A word of warning, however: this information should always be checked and confirmed. Nothing published in any careers booklet goes out of date so quickly as information on salaries and wage rates. No one can do more than make an estimate of likely prospects, but occasionally official reports are issued which do give some indication of the future supply and demand within certain occupations. These reports, or relevant extracts, can always be consulted at the local youth employment office.

9. *Local availability.* Whether or not the career is available within reasonable daily travelling distance of home, or whether you would have to leave home in order to find the right opening, is the final, but not the least important, thing to know. If the latter, then certain other considerations, including your age and the cost of living accommodation in another area, need to be reviewed and weighed in the balance against the advantages. If such employment is of a "craft" kind, and involves recognized training, you can, in certain circumstances, qualify for financial assistance within the terms of the training allowances scheme administered by the ministry of labour and national service. Full details of this scheme are obtainable from every youth employment office.

Probables and Possibles

As you undertake this fact-finding survey of each career on your short list, you will most likely be measuring yourself against each requirement as it comes to light. You may wonder whether you fall too far short in some particular, or whether the required standards can be attained in the future. For one reason or another, some of the careers previously short-listed will already have been eliminated. With those that remain—perhaps in two lists labelled "probables" and "possibles"—you may be pondering over the level of entry at which to aim or, if that is more or less settled, whether you can commit yourself with reasonable chances of success to this or that particular course of study or training. These doubts are natural. In fact, a match which seems perfect and does not raise any doubts is to be suspected. It might be that your aim is set too low.

To settle these doubts, you and your parents should at this stage certainly seek outside help and advice. Accurate self-assessment is impossible. No one can ever see himself in relation to these career requirements as others see him. Parents can give invaluable help with their intimate knowledge of your inclinations, temperament, and health, but they are not in the best position to assess, with any degree of surety, your particular abilities, levels of academic attainment, and future promise. It is to the school teacher, therefore, that you must look for candid opinions and assessments. Without the vital information he can supply, the whole of this matching process, as far as educational requirements and levels of entry are concerned, must be suspect.

The teacher's help will go a long way, but you and your parents may still be too doubtful to reach a firm decision. The local youth employment officer exists specially to meet the need for some impartial person with whom such doubts can be discussed in the strictest confidence. These officers are all men and women with a wide knowledge of careers and considerable experience in helping young people to find their right vocation. They work in close co-operation with heads of schools on the one hand and employers on the other, and are available for vocational advice long before the school-leaving date is reached. When this time does arrive, the officer can assist with the finding of an actual vacancy with an employer. If, too, at any subsequent time (up to the age of 18) a change of employment is found desirable, the officer is again available to offer the advice and the facilities of the service. Helping boys and girls to make the right choice of career is *his* vocation, and certainly the youth employment officer should not be regarded merely as a job-finding agency. There are youth employment offices or bureaux in every district. The facilities they offer are entirely free. In most areas the service is administered by the local education authority, in the others by the ministry of labour and national service. The address of the nearest office can be obtained from your local education office, employment exchange, or post office.

During the gathering together of these facts and the seeking of this advice, you will have noted two major facts which can make or mar your choice of career. First, and bearing in mind that everyone has a different ability and a different level of possible attainment, it is of great importance to your life's work that you should develop *your* particular abilities to the limit of which you are capable. Secondly, it is equally important that you should aim at entry into your chosen career at a level which matches that limit. To aim too low will lead to wasted abilities and eventual frustration; to aim too high may lead only to disappointment. To aim reasonably high, at a level that will give scope for your ambitions and satisfaction in your work, is obviously the ideal.

The Final Choice

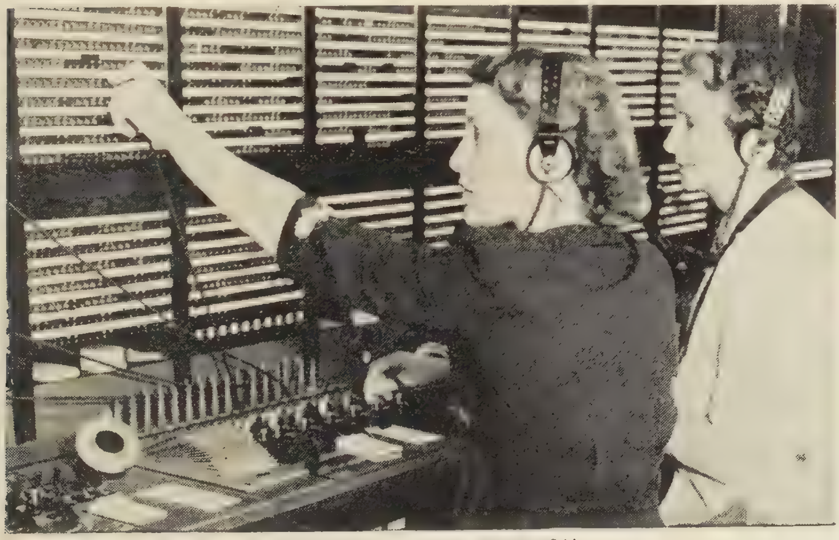
In making your final choice, it is wise to remember the saying which begins "There's many a slip . . ." Some applications for employment, or for admission to this or that course of training or further study, have to be turned down. It is best, therefore, not to confine your final short-list to only one specific career.

At this stage the obvious difference for girls is the possibility that marriage may be the ultimate career. For this reason, parents are sometimes unwilling to provide higher education for their daughters. Employers, too, are sometimes chary of investing time and money in the training of girls whose eventual contribution in return may be cut short by marriage. A girl herself often enters on her choice with a vague feeling that it is only a

FARMERS, TEACHERS, AND TELEPHONIST

On the left students of the Royal Agricultural College, which is situated at Cirencester, are learning about the care of Friesian cows. The college is a farmers' university, because here students attend a two-year diploma course and are given instruction in all branches of agriculture. There is a 700-acre farm with pigs, poultry, and a herd of cows, and also a 45-acre smallholding. No special qualifications are needed for entry here.

Prospective domestic science teachers in rural schools, who take the teachers' training course at the Gloucestershire Training College of Domestic Science, spend one day each week at the Farm Institute at Hartbury, where they do practical work in poultry-keeping, horticulture, and cheese-making. In this picture (right) a class is receiving instruction on how best to record the number of eggs laid by a given hen.



The telephonist on the left has completed her training, and is undergoing her final qualifying test at the training school of the General Post Office at Canterbury, Kent. Besides her technical ability, a telephonist should have a pleasant, clear voice, an equable temperament, and the ability to concentrate for long periods. Exchanges dealing with calls to or from foreign countries are staffed by operators with exceptional ability and a knowledge of some foreign languages.

H.M. Postmaster-General

temporary phase in her life and that anything reasonably suitable will do for a short time. It is also true, despite the achievements of the few and the wider recognition now accorded to the principles of equal pay and equal opportunity, that women have not yet, in most occupations, anything like the same scope for advancement as men have, and that therefore the great majority of responsible posts are held by men.

Yet the girl leaving school is well advised to choose her career or course of future training with the idea that her chosen work is going to last for a long time. She may not get married. If she does, she may wish to return to her chosen work after her children can fend for themselves. She may wish to supplement the family budget, or may have to become the breadwinner. Moreover, not all marriages produce children; and in any event a woman with an interesting job, be it science, journalism, fashion designing, or whatnot, will not wish to abandon it entirely. Like the boy, therefore, a girl should choose her career on the same methodical lines and with the same aims in view.

Finally let us re-state the main arguments.

At the outset, stress was laid on the need for a thoughtful and systematic approach. There followed a survey of the field of careers in general, and the choice was narrowed first by grouping, and secondly by reference to the individual careers contained in the list on pages 246-256. At that stage we recommended the compiling of a short list of "probables" and "possibles" and the seeking of detailed information about the requirements of each of them, followed by a measuring of yourself against those requirements with the help of parents, teacher, and youth employment officer. Finally came the advice that you should keep some other choices up your sleeve, in case of need.

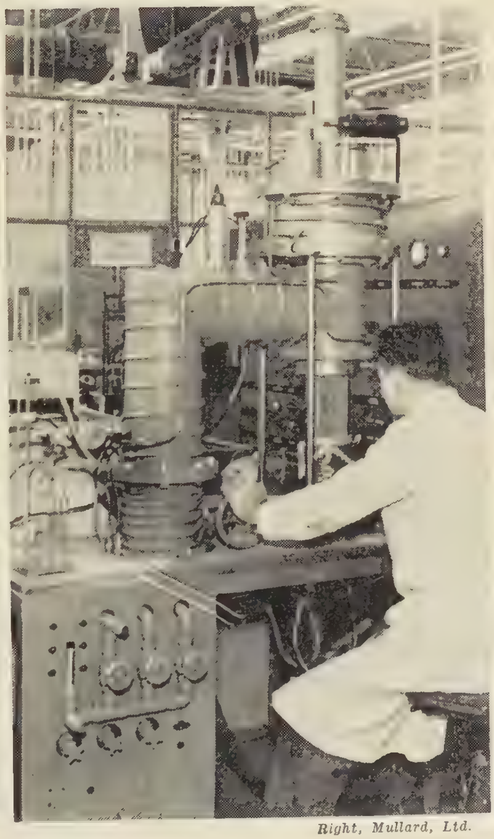
GROUP	CAREER	SCOPE
PRACTICAL	Chemistry	In INDUSTRY, *e.g.* Agriculture
Applied sciences,	Physics	Chemicals
technologies, tech-	Biology	Engineering
nical and practical	Zoology	Building
skills	Botany	Textiles
	Biochemistry	Shipbuilding
	Microbiology	Oils and Fuels
	Bacteriology	etc.
	Pathology	
	Veterinary Science	
	Agriculture (general)	In the scientific and technical branches and
	Agriculture (dairying)	departments of the
	Agriculture (poultry)	CIVIL SERVICE,
	Horticulture	LOCAL GOVERNMENT services and other
	Forestry	public utility services,
	Geology	*e.g.* GAS BOARDS
	Metallurgy	CENTRAL ELECTRICITY AUTHORITY
	Fuel Technology	NATIONAL COAL BOARD
	Rubber Technology	B.B.C.
	Glass Technology	
	Textile Technology	
	Meteorology	In H.M. FORCES and the
	Engineering—Aeronautical	MERCHANT NAVY
	,, —Agricultural	
	,, —Atomic	
	,, —Automobile	According to individual preferences and
	,, —Chemical	circumstances, some who take up these
	,, —Civil	careers may turn to TEACHING, and so pass
	,, —Electrical	on their knowledge, experience, and skills
	,, —Electronic	to others in schools, technical colleges,
	,, —Gas	universities, etc.
	,, —Heating and Ventilating	
	,, —Marine	
	,, —Mechanical	
	,, —Mining	Others may be employed in
	,, —Municipal	RESEARCH AND DEVELOPMENT
	,, —Production	SALES AND TECHNICAL SERVICES
	,, —Radio and T/V	ESTIMATING or COSTING
	,, —Railways	WORKS MANAGEMENT or
	,, —Refrigeration	ADMINISTRATION
	,, —Sanitary	
	,, —Structural	
	,, —Telecommunications	
	,, —Textile	

GROUP	CAREER	SCOPE
PRACTICAL *(Continued)*	Surveying—Building ,, —Mining Coalmining—Managerial ,, —Technical Pharmacy Optician (dispensing) Dental Technician Laboratory Technician Draughtsmanship Cartography H.M. Forces Seafaring Crafts and trades within— Engineering, *e.g.*, fitter, tool-maker Building, *e.g.*, joiner, plumber Printing Agriculture Furniture Manufacture Boot and Shoe Manufacture Baking and Confectionery etc.	
SOCIAL Involving some scientific or technical knowledge, sometimes coupled with practical skill More "purely" social in so far as technical equipment or apparatus is not generally involved	Medicine and Surgery Dentistry Nursing Physiotherapy Orthoptics Chiropody Audiology Radiography Radiotherapy Occupational Therapy Speech Therapy Optician (ophthalmic) Pharmacy (retail) Dispensing Teaching (of scientific or technical subjects) Factory Inspectorship Sanitary Inspectorship Institutional Management Dietetics Catering Demonstrating Hotel Management Hotel Receptionist Receptionist (dental) Hairdressing and Beauty Culture Salesmanship Teaching (general) Teaching (handicapped pupils) Child Care Nursery Nurse Minister of Religion Probation Officer Housing Management Personnel Management Youth Employment Officer Youth Leadership Home Teaching of the Blind Welfare Officer Mental Health Worker Police Force	In PRIVATE or GENERAL PRACTICE, HOSPITALS and CLINICS, etc. In the educational, scientific, medical, and technical branches and departments of the CIVIL SERVICE and LOCAL GOVERNMENT services, particularly Public Health and Education In SCHOOLS, SHOPS, HOTELS, RESTAURANTS In INDUSTRY In H.M. FORCES Some of those who take up these occupations may eventually choose to TEACH their particular profession in schools, technical colleges, training establishments, or universities, etc. Others may turn to ADMINISTRATION

GROUP	CAREER	SCOPE
ABSTRACT Pure sciences	Chemistry Physics Mathematics Astronomy Biology Zoology Botany Biochemistry Microbiology Bacteriology	In the scientific, technical, administrative, executive, and clerical branches of the Civil Service, Local Government services, and other public service bodies, *e.g.* Central Electricity Authority National Coal Board Gas Boards B.B.C. London Transport etc.
Technical/Words	Patent agency Technical librarianship Technical journalism	
Words/Social	Barrister Solicitor Librarianship Journalism	In Professional, Commercial, and Industrial Offices
Words	Linguist Shorthand-typist Typist Advertising Dramatist	In Private Practice The majority of " pure " scientists are to be found engaged in Research work or in Teaching. The latter also provides much of the scope for the linguist.
Words/Figures	Estate agency, valuation Auctioneering Insurance Company Secretary Economist Customs and Excise Inland Revenue Administration Clerical work	
Figures	Actuarial work Statistics Accountancy Surveying (quantity) Banking Calculating-machine operating	
ARTISTIC Applied art or work entailing some creative or artistic ability allied with technical knowledge	Architecture Photography Draughtsmanship Designing Printing (Lithography and Photogravure) Process Engraving Signwriting Bookbinding Commercial Art Fashion Designing Interior Decorating Floristry	In Private Practice Commerce Industry Civil Service Local Government services and other public utility bodies In the Theatre, Films, Radio, and Television Although some who take up work within the first group (i.e., that which calls for an applied art) turn to Teaching, Research and Development, Sales Technical and Advisory Services, or Administration, the majority are engaged on the work itself.
Pure art	Music Painting Sculpture Acting Dancing	On the other hand, many of those working in the field of pure art take up Teaching.

The Times

Cadets for the Merchant Navy can prepare for a seagoing career in several ways. They can serve an apprenticeship with a shipping company, or receive preliminary training at a nautical school or college. A cadet can choose between becoming a watch-keeping officer, an engineer, or joining the purser's department. These young seamen are from a nautical college in Yorkshire.



Right, Mullard, Ltd.

Technical colleges offer full-time courses for students of 16 years and over in dressmaking, pattern-cutting, tailoring, and trade embroidery. The period of training varies from two to three years, according to the subjects selected. The adult students in this picture are creating their own designs. Firms connected with the radio industry employ physicists (right-hand picture), electrical engineers, and specialists in the many branches of electronics.

CAREERS AT A GLANCE

Thumbnail sketches of approximately 100 careers are appended, particulars being given in the following order in every case :

1. A brief outline of the work and its setting.
2. What the work calls for in the way of personal qualities.
3. Educational requirements.
4. Training.

ACCOUNTANCY

1. Analysing and verifying financial transactions; advisory work on taxation, executorship, insolvency, etc.
2. Aptitude for figures, patient attention to detail, clarity in writing reports.
3. Employers expect candidates to have sufficient passes in G.C.E. to exempt them from preliminary professional examinations, English and mathematics being generally stipulated as two of the subjects.
4. Normally 5 years' practical training as articled clerk in accountant's office (3 years for certain university graduates), with part-time study for professional qualifications.

ACTUARIAL WORK

1. Specialised statistical work, mainly in insurance and some government departments.
2. A definite flair for mathematics; patient attention to detail.
3. Minimum requirement for admission to Institute's entrance examination is 5 passes "O"-level G.C.E. (including mathematics and English). Preferable to take university course in mathematics or statistics or acquire "A"-level mathematics.
4. Practical experience in office with part-time study for professional qualifications.

ADVERTISING

1. The promotion of sales. Includes press and poster publicity, window display, films, still photography, etc.; market research; copywriting, layout, planning, commercial art, together with supporting accounting, administrative and clerical activities.
2. Initiative, sociability, imagination. For copywriting and artistic work—creative ability; for market research—patient attention to detail, some knowledge of economics.
3. Good general education essential—4 passes "O"-level G.C.E. if professional examinations are envisaged.
4. Practical training "on the job" with part-time study for examinations of the Advertising Association, or Institute of Incorporated Practitioners in Advertising. For layout work—the National Diploma in Design or experience and qualifications in printing.

AERONAUTICAL ENGINEERING

1. Design and construction of air-frames, engines, hydraulic and electrical contact systems, propellers, etc.

2. 3. and 4—as for ENGINEERING.

AGRICULTURAL ENGINEERING

1. Design, manufacture, sale, maintenance, and repair of farm machinery including tractors, combine harvesters, etc.
2. As for ENGINEERING, plus love of country life and some knowledge and appreciation of farming theory and practice.

3 and 4 As for ENGINEERING.

AGRICULTURE

1. General—practical farming and farm management. Dairy-breeding, managing, feeding, production of milk and home-grown fodder. Poultry breeding, rearing, and feeding; egg production and marketing; preparation of table poultry. Specialist services—teaching, research, inspection, or advisory work.
2. Good health, love of country life, practical aptitude, ability to handle animals, some "business" sense if owning a farm is the aim.
3. Educational qualifications differ according to the work envisaged :

(a) University degree courses of 3–4 years leading to B.Sc. Agriculture or Dairying require university entrance requirements "A"-level G.C.E.

(b) Diploma courses of 2 years leading to National Diploma in Agriculture or Dairying or Poultry Husbandry—4 or 5 passes "O"-level G.C.E.; (a) or (b) needed for specialist services.

(c) Farm Institute courses of 1 year (mainly practical)—no special educational requirements.

4. All courses of training have to be preceded by at least one year's approved practical farm work. Special schemes of recruitment: (a) Y.M.C.A. Farm Training Scheme, (b) Town Boys' & Girls' Farm Training Scheme. An Agricultural Apprenticeship Scheme (3 years) gives opportunity for approved practical training "on the job."

AIR STEWARDESS

1. Care of passengers, particularly women and children: helping in preparation and serving of meals and refreshments.
2. Good looks and manners; tact; practical, physically fit, well spoken, single, be ready to serve in any part of the world and accept long spells away from home, irregular hours, aged between 20–28. Calm in emergency. Able to speak well at least one foreign language.
3. Good standard of general education—no specific qualifications. Previous knowledge and experience of nursing, catering, or first-aid an undoubted advantage.
4. Training given by airline employers. Competition for posts is intense. Flying duties relinquished on marriage.

ALMONER

1. A social case worker whose primary function is to help medical staff by resolving the personal and social problems which may be hindering a patient's recovery.
2. Good health, emotional maturity, a sincere desire to help people.

3 and 4. A university degree, diploma, or certificate in social studies, followed by a specialised course arranged by the Institute of Almoners.

ARCHITECTURE

1. The design of buildings, supervision of their erection, alteration, etc. Dealing with clients, surveyors, and builders.
2. Creative artistic ability; imagination plus practical and technical outlook.
3. For entry as student of the Royal Institute of British Architects the minimum requirement is "O"-level G.C.E. passes in English, mathematics, and three other subjects.
4. (a) 5 years' full-time course at a school of architecture followed by one year's practical pupilship.

(b) 3 years' full-time study to Intermediate R.I.B.A., followed by practical work as an assistant in an office while studying for the Final.

(c) Articled pupilship or service as a junior with part-time day and evening classes. At any point in training the part-time student may change over to a full-time course.

AUCTIONEERING (& ESTATE AGENCY)

1. Selling, leasing, managing, and valuing property; surveying of real estate; advising on questions of rent, maintenance, and repairs, etc Some auctioneers specialise, *e.g.*, in buildings, antiques, cattle, etc.
2. Alertness, sound judgment, and a flair for confident public speaking.
3. Good general education is essential.

(a) The Chartered Auctioneers' and Estate Agents' Institute—4 "O"-level G.C.E. passes, including English language and mathematics.

(b) The Incorporated Society of Auctioneers and Property Agents—a minimum of "O"-level passes in English language and mathematics.

4. (a) Full-time university course (Cambridge or London), followed by practical experience.

(b) Three years' "articled pupilage," plus part-time study for professional qualifications.

(c) Experience as a junior, plus part-time study.

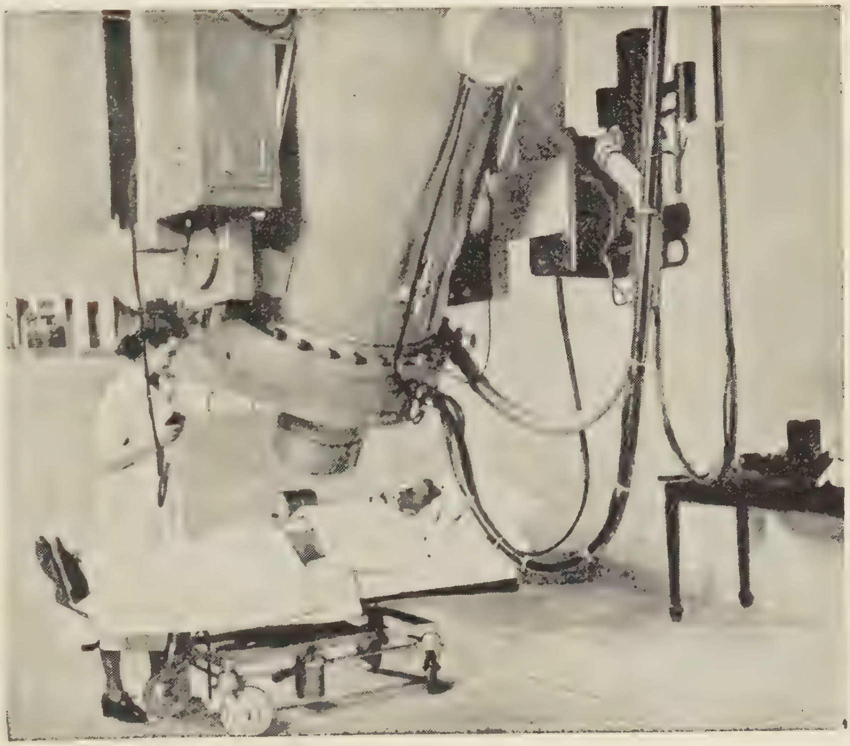
AUDIOMETRICIAN

1. Testing a patient's hearing capacities (under supervision of medical staff); providing, fitting, and servicing hearing aids.

Crown Copyright

Training schools for nurses are maintained by the large general hospitals, and student nurses attend lectures in anatomy, physiology, and all departments of medicine, and in the treatment of wounds. The nurses seen here are "reading" an X-ray photograph under the guidance of a doctor. Student nurses serve a period of probation to see if they are temperamentally and physically suitable for this exacting but very rewarding profession.

A radiographer is a highly skilled person trained in either diagnostic or therapeutic radiography, working in the X-ray departments of hospitals and clinics under the direction of a medical specialist. Diagnostic radiography is a specialised photographic technique whereby parts of the body can be photographed inside the body by means of X-ray apparatus. Therapeutic radiography (right-hand picture) is a method of treating disease by means of high voltage X-rays. The work is highly exacting and extremely interesting, and demands a high degree of concentration and accuracy from the radiographer. Because sick people are anxious, and often in pain, the radiographer should have a cheerful and sympathetic disposition.



2. Patience and kindly, sympathetic manner.
3. Good general education required, with reasonable ability in physics; some knowledge of sound and electricity an advantage.
4. Training available at the Institute of Laryngology and Otology—three months' full-time, followed by nine months' practical work as an apprentice technician with part-time study for examinations of the Society of Audiology Therapists and Technicians. Girls preferred.

AUTOMOBILE ENGINEERING

1. Design, development, production, maintenance, and repair of all types of vehicles propelled by the internal-combustion engine.
2, 3, & 4. See ENGINEERING.

BACTERIOLOGY

1. A comparatively narrow and specialised branch of science:
(a) Medically qualified bacteriologists generally work in pathological laboratories of hospitals or in public health service investigating diseases caused by bacteria.
(b) Non-medical bacteriologists assist in hospitals or are employed in the Scientific Civil Service on soil fertility, milk testing, etc., or in industry (chemical manufacture, food processing, brewing, etc.).
2. Painstaking scientific attention to detail, good vision (including colour), ability to work as one of a team.
3. University degree in medicine, chemistry, or bacteriology essential.

BANKING

1. Dealing with customers' financial accounts, exchange of cheques, advancing of loans, acting as executors and trustees.
2. Tactful pleasant manner, smart appearance, impeccable integrity.
3. *Boys:* Most banks seek 4 or 5 passes "O"-level G.C.E., including mathematics and English. An advantage to gain "A"-level passes.
Girls: Good general education to 16. "O"-level passes in English and mathematics an advantage.
4. Training is practical; juniors encouraged to study part-time for examinations of Institute of Bankers. Girls are usually required to train initially as calculating-machine operators or shorthand-typists. Women are increasingly employed as cashiers.

BARRISTER (ADVOCATE in Scotland)

1. A specialist legal adviser who acts in the higher courts. Is briefed by solicitor and does not deal directly with clients. Specialises in either Common or Chancery Law. Legal training and qualifications are very valuable assets in other spheres of work.
2. Logical thinking, clear expression both verbally and in writing; an ability to assimilate and marshal facts speedily and thoroughly; good strong personality, impartiality and integrity.
3. Candidates must be of university entrance standards with "A"-level passes G.C.E. in English and Latin.
4. Training extends over 3 years. Most students take degrees either before starting professional training or after admission as a student at one of the Inns of Court. Exemption from all or part of Bar examinations may be granted to university graduates in Law. Successful students over the age of 21 may be called to the Bar but will not practise until having served one year of practical pupilage "in chambers."

BEAUTY CULTURE (see HAIRDRESSING)

BIOLOGY

1 The science of living things in all forms. Biologists are employed in teaching, research, and advisory work in agriculture, horticulture, forestry, fishing, and the manufacture of foodstuffs, chemicals, etc.
2. Painstaking scientific attention to detail and logical expression in speech and writing.
3. Prospects very limited without a university qualification.
4. In general, openings for biologists are fewer than for other scientists.

BOOK-PUBLISHING

1. Organising the printing, publicity, and sale of books of all kinds. Editorial department deals with selection of material and negotiations; production department deals with estimated costs and sizes, printing, binding, layout, art illustrations, etc.; publicity and sales departments cater for commercial side.
2. Business acumen, good judgment, ability to estimate public taste, a real love of books.
3. Good general education. G.C.E. "O"-level passes desirable, particularly in English and a foreign language. A pass in art also useful.
4. No special training schemes—all training "on the job."

BREWING

1. The malting of barley, and the brewing (mashing, hop-boiling, fermenting) and bottling of beer.
2. A knowledge of science and engineering most useful, good organizing ability, good health, and a readiness to undertake night work.
3. For Institute of Brewing examinations—"A"-level passes G.C.E. in mathematics, physics, and chemistry, with "O"-level in English.
4. (a) University degree followed by post-graduate course or a 3-year diploma course, followed by practical training; a 2-year certificate course also available.
(b) 2 years' practical training as "pupil," with part-time technical college or other similar studies for examinations of the Institute.

BUILDING

1. Erection, maintenance, and repair of houses, schools, public buildings, etc. Includes the crafts of bricklaying, plastering, carpentry, plumbing, tiling, painting, electrical contracting, etc.
2. A practical aptitude, good health and physique, good head for heights, ability to work as one of a team.
3. Good general education with reasonable abilities in arithmetic, English, and craft work.
4. Apprenticeship training of 5 years, supplemented by trade classes and the examinations of the City and Guilds of London Institute.

BUILDING—MANAGERIAL, EXECUTIVE, AND TECHNICAL

1. Supervision and administration of building work by private firms or public bodies. In large organizations this work is departmentalised, *e.g.*, estimating and contracts, inspection, stores, clerk of works.
2. Organizing ability, powers of leadership, ability to handle staff.
3. (a) G.C.E. with "A"-level passes in mathematics and science for students taking full-time technical courses.
(b) Ordinary National Certificate in Building for craftsmen going on to part-time or full-time study for management.
4. Full-time study at technical college or practical experience as an apprentice plus part-time study. In both cases these lead to Higher National Certificate in Building.

BUILDING SOCIETY WORK

1. Provision of a mortgage service to help people build or buy their own houses. Advances made from funds raised by investment in the society.
2. Business acumen, integrity, ability to win confidence.
3. Four passes "O"-level G.C.E. including English and mathematics.
4. Practical experience in an office, with part-time study for the examinations of the Building Societies' Institute.

CALCULATING MACHINE OPERATING

1. Working of accounting machines, of which there are many different types (*see* CALCULATING MACHINE, page 172).
2. Accuracy, neatness.
3. Good general education—special ability in arithmetic. Some knowledge of book-keeping an advantage.
4. Some large firms and most manufacturers of calculating machines have their own training schools.

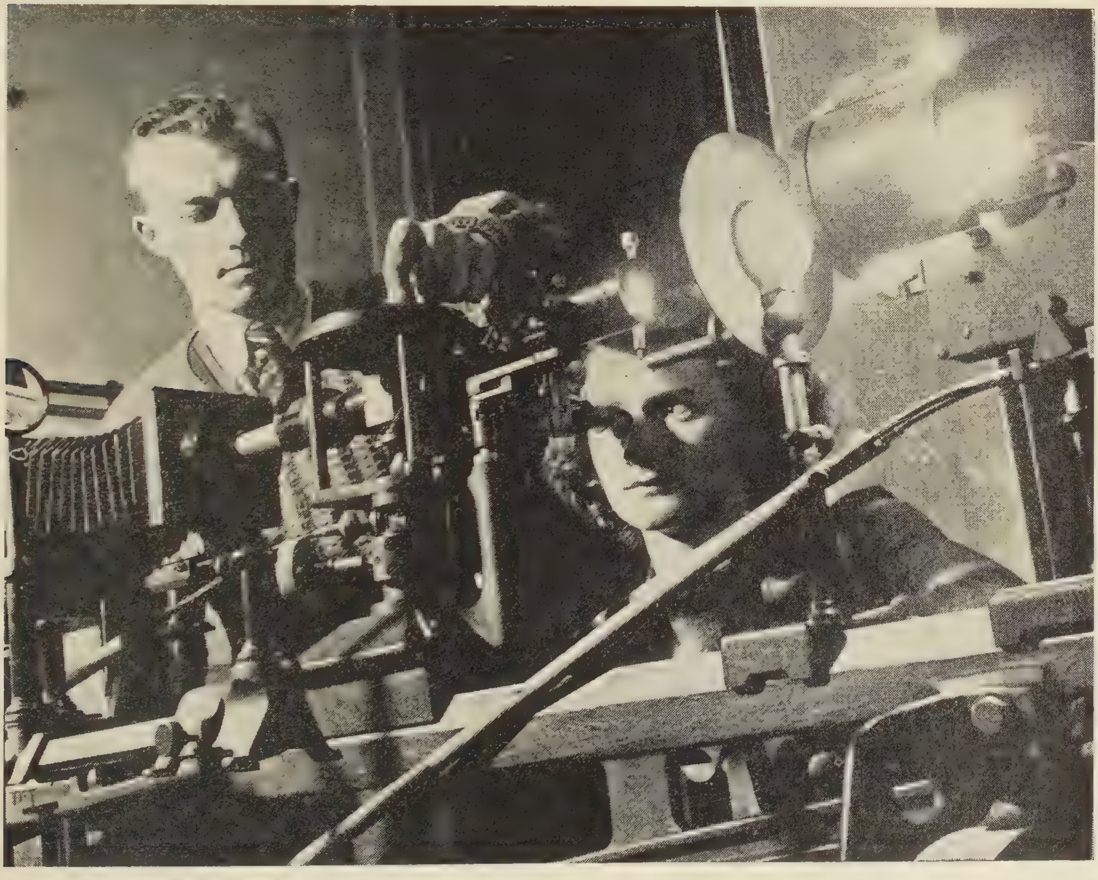
CATERING (see HOTEL AND CATERING)

CERAMICS

1. Pottery design and manufacture:
(a) management, production, staffing, and sales;
(b) chemistry—testing strength and durability of product, research, new processes and plant, etc.;
(c) design—relatively few openings for artists.
2. (a) Management—ability to handle staff and organize; practical ability for production work.
(b) Chemistry—painstaking; scientific approach.

Right, The Times

The veterinary surgeon must take a five-year course at a university's veterinary school (left-hand picture) before starting to practise. In general, the prospective veterinary surgeon should have a real understanding of animals, the ability to get on well with people, and a sound business instinct. Printers (picture on right) usually have to serve an apprenticeship of from five to seven years, during which period they also attend technical classes.



The metallurgist applies the principles of chemistry and physics to the study of metals, and there are posts for metallurgists in research and production both at home and abroad. Entrants should obtain a university degree in metallurgy. The work is varied, and in the laboratory the metallurgist tests metals for purity and for flaws, as in this photograph. He should be conversant with such processes as forging, pressing, and stamping.

3. For management—G.C.E. " O "-level passes in physics and chemistry ; for chemistry—at least " A "-level passes in same subjects.
4. Sandwich course, full-time or part-time study for Pottery Managers' Certificate. Chemists take full or part-time courses for Diploma in Ceramics.

CHEMICAL ENGINEERING
1. Design, construction, and operation of chemical manufacturing plant ; research development and administration.
2, 3, and 4. See ENGINEERING.

CHEMISTRY
1. Science of composition of matter (biochemistry—of living things). Research, development, analytical control, teaching.
2. Practical ability, patience, scientific attention to detail.
3. G.C.E. " O "-level passes in mathematics, English, and chemistry are a minimum. A knowledge of German an advantage.
4. (a) University degree course followed by practical experience.
(b) Practical experience in laboratory with part-time study for external degree, or Associateship of the Royal Institute of Chemistry, or for Higher National Certificate.

CHILD CARE
1. A local government service ; finding and investigating of foster-homes, supervision of children, adoption, and after-care work.
2. Tact, good judgment, mature outlook, genuine love of children.
3. Good general education. For senior posts, graduate in social science or experience in teaching, health visiting.
4. Arranged by Central Training Council for Child Care.

CHIROPODY
1. Diagnosis and skilled treatment of minor foot ailments.
2. Social aptitudes, skill with hands, good eyesight, business acumen if in private practice.
3. For entry into a recognized training school—4 G.C.E. " O "-level passes including English, mathematics, and a science.
4. Three-year full-time training for Membership of the Society of Chiropodists.

CHURCH WORK
1. Conducting religious services, teaching, visiting, committee work, individual advisory work. Some ministers act as chaplains to schools, hospitals, prisons, H.M. Forces, or as tutors, missionaries, etc.
2. The overriding need is a sense of vocation to the Christian ministry.
3. No specific requirements stipulated but, in general, 4 or 5 " O "-level passes G.C.E. are needed to satisfy college entrance examinations and fit candidates for further study. University degree usual for Church of England, an advantage in other churches.
4. Full-time or perhaps part-time courses of study as arranged by appropriate church authorities.

CIVIL AVIATION
1. Air passenger and freight services. Many different occupations involved :
(a) Flying staff—pilots, navigators, radio officers, engineers, stewards ;
(b) Administrative staff—stores, accounts, reservations, catering supplies, etc.
2. (For a) High standard of physical fitness, good eyesight, readiness to serve long spells away from home in any part of the world.
(For b) Depends on particular branch of administration entered ; generally speaking, candidates need to be methodical, sociable, of smart appearance, and able to work well as one of a team.
3 and 4. Good general education, with relevant qualifications for particular occupation entered. Airline companies arrange practical training courses.

CIVIL ENGINEERING
1. Design, construction, and maintenance of railways, roads, bridges, harbours, airports, power stations, water supply, sewage services, etc.
2. Practical and mathematical aptitude, initiative, readiness to accept responsibility, good health, ability to lead, organize, and handle staff.
3. For acceptance by Institute of Civil Engineers—
(a) G.C.E. " O "-level passes in English, mathematics, and 2 sciences, or 1 science and a foreign language, or—
(b) Preliminary examination of the Engineering Joint Examination Board, or—
(c) University degree in Engineering.
4. Full-time university or technical college course followed by 2 years' practical experience as " graduate assistant," or as apprentice or pupil for 3 or 4 years with part-time study for A.M.Inst.C.E. examination, or for O.N.C. in Mechanical or Electrical Engineering or Building followed by H.N.C. in Civil Engineering.

CIVIL SERVICE
1. Administration and execution of government policy and decisions. Numerous different occupations, many of technical, specialised, or scientific kind in the Scientific Civil Service.
2. Personal qualities required vary with the branch of the Serivce entered ; in general, a strong sense of duty is needed.
3. Educational requirements differ widely according to the various grades and appointments. These can be classified as follows :
(a) Clerical assistants, machine operators, shorthand-typing and typing grades, etc.—good general education.
(b) Clerical class—" O "-level G.C.E. standard on entry—carries out bulk of clerical work ; various grades within the class.
(c) Executive class—" A "-level G.C.E. standard on entry—performs more responsible, technical, or supervisory work. Some train as departmental specialists.
(d) Administrative class—university graduate standard on entry. Responsible for policy, organization, methods, etc.
Some Departments, *e.g.* Ministry of Labour and National Service, Customs and Excise, and Inland Revenue have their own staffs roughly equivalent to above gradings. *Scientific Civil Service :* assistants (scientific) need to have " O "-level G.C.E. passes in 4 subjects including English language and mathematics or a science. Assistant experimental officers exercise greater responsibility and require G.C.E. " A "-level passes in mathematics or science subjects. Other scientists employed : university graduates.
4. Training giving within the Service. Further information obtainable from the Civil Service Commission, Burlington Gardens, London, W.1.

COLONIAL SERVICE
1. Administrative, professional, and technical work in public services of Colonies for which Secretary of State for the Colonies is responsible—openings generally in agriculture, education, engineering, medicine, survey, and veterinary services. Openings for women in education, medicine, nursing, and social welfare.
2. Good health ; candidates must be British subjects.
3. University degree or other relevant professional qualifications generally required.
4. Training arranged by Colonial Office.

COAL MINING (Management)
1. Manager an important official responsible for supervision, organization, and safety.
2. Practical aptitude, high sense of responsibility, powers of leadership, physically fit.
3. Good general education, preferably with " O "-level G.C.E. passes. Preliminary stage of examinations for 1st Class Certificate of Competency (without which one cannot practise as a colliery manager) will be excused if candidate has " O "-level passes in English, mathematics, and one other subject.
4. (a) Full-time university degree course followed by at least 3 years' practical experience, or—
(b) Part-time study at technical college with at least 5 years' practical experience.

COMMERCIAL ART
1. Covers a very wide field—advertisements, illustrations for books and magazines, lettering, fashion drawing, etc. Industrial designing for pottery, glassware, textiles, carpets, wallpaper, furniture, household appliances, etc.
2. Very good artistic and creative ability, imagination, good eyesight, some business acumen if working " free-lance."
3. Good general education and specialised art training.
4. Full or part-time study for the National Diploma in Design or Intermediate Certificate in Arts and Crafts.

COMPANY SECRETARY

1. Responsible for company administration, control of staff, all meetings of board of directors and shareholders. Is legal representative of the company.

2. Good judgment, sense of responsibility, good organizer, sociable, able to speak well in public.

3. Good general education to at least " O "-level G.C.E. ; 4 " O "-level passes including English, mathematics, history, or geography qualifies for exemption from preliminary examinations.

4. Practical training in office with part-time study for approximately 5 years for examinations of Chartered Institute of Secretaries (A.C.I.S.) or Corporation of Certified Secretaries (A.C.C.S.).

DANCING

1. Two main branches :
   (a) theatre (ballet, opera, revue) ;
   (b) teaching.

2. Physical fitness, sense of rhythm, good musical ear, readiness for constant practice. For theatre work—some talent for acting and a height between 5 ft. 2 in. and 5 ft. 5 in.

3. A good general education. For teacher training—G.C.E. " O "-level passes in French, English language, English literature, one other arts subject, and preferably biology.

4. Training, especially for ballet, must start at an early age, and is available at special dancing schools. For teaching, 3 years' training course at the Royal Academy of Dancing. The Imperial Society of Teachers of Dancing offers a Teaching Diploma.

DEMONSTRATING

1. Practical demonstrating of household appliances, cookery techniques, etc.

2. Good personality, ability to talk well and convincingly, patient attention to detail, good homecraft ability.

3. Educational requirements differ, but for most posts should be G.C.E. standard.

4. Majority of appointments call for specialised teacher training or qualifications in domestic science. Training available at a number of colleges, the Good Housekeeping School of Cookery, or through the Electrical Association for Women.

DENTAL SURGERY ASSISTANT

1. Reception and clerical work, care of instruments, preparation of filling and impression material, general " chair-side " assistance.

2. Smart appearance ; pleasing, confident manner.

3. Good general education, but personality and appearance of more importance.

4. Training generally in the employ of a dentist or at a training school (2 in London, 1 in Bristol). Nursing or first-aid experience an advantage.

DENTISTRY

1. Diagnosis and treatment of diseases of jaw, gums, and teeth—filling, crowning, extracting, etc. Design and fitting of artificial dentures.

2. Good health and eyesight, manual dexterity, patience, confident manner.

3. University qualification essential.

4. At least 5 years' specialised training.

DENTAL TECHNICIAN

1. Manufacture and repair of artificial dentures.

2. Good eyesight, accuracy, practical aptitude.

3. No special educational qualifications—some knowledge of physics and chemistry an advantage.

4. Five years' apprenticeship with a dentist or manufacturing firm, with part-time study for City and Guilds Certificates.

DIETETICS

1. Application of scientific principles to feeding, particularly in schools, hospitals, etc.

2. Scientific attention to detail, good organizing ability, an interest in people.

3. G.C.E. passes at " O "-level in English language, chemistry, and 3 others ; mathematics an advantage.

4. Training covers 4–5 years, and full-time Diploma courses are open to those with domestic science or scientific qualifications, and also available to State Registered Nurses and holders of the Catering Management Certificate of the Institutional Management Association and of the Hotel and Catering Institute.

DISPENSING

1. Assisting pharmacists in hospitals or retail shops.

2. Good eyesight and colour vision. Accuracy and interest in medicine.

3. Good general education.

4. Practical experience with part-time study for Certificate of the Society of Apothecaries.

DOMESTIC SCIENCE

1. Housekeeping, catering, cooking in schools, canteens, hospitals, etc. Needlework, laundry, care of furnishings ; may also include demonstrating, care of children, or teaching of these subjects.

2. Organizing and teaching ability, ability to control staff, creative sense with good craft work, left-handedness a disadvantage for teaching and demonstrating.

3. Usual G.C.E. requirements for university or teacher training courses ; 3 passes at " O "-level G.C.E. (including English) for Institutional Management Certificate course ; no special qualifications for other courses.

4. Full and part-time training courses available in most areas.

DRAMATIC ART

1. Acting, production, and stage management ; teaching.

2. Personality, imagination, good memory, good voice, sound health, presentable appearance (not necessarily good looks), determination.

3. No special qualifications, but for a university Diploma in Dramatic Art candidates need passes in G.C.E. in English and at least two other subjects at " O " level.

4. Full-time training at one of the academies or practical experience with a repertory company as a student. For teaching, a 3-year training course.

DRAUGHTSMANSHIP

1. (a) Cartographical—drawing scale maps from field surveys, Ordnance Survey Department (a Civil Service appointment).
(b) Engineering and technical—preparation of scale drawings prior to manufacture.

2. Accuracy, patient attention to detail.

3. Good general education, preferably to " O "-level G.C.E. with passes in mathematics and science.

4. (For a) Practical training, leading to outside field survey duties.
(For b) Five-year apprenticeship, with part-time study for Ordinary National Certificate or other professional examination.

DRESS DESIGN

1. Found in all branches of the dress trade :
(a) Haute couture—models for individual customers, export.
(b) Wholesale couture—special models based on fashion trends with somewhat restricted sales.
(c) Wholesale manufacturing—large-scale production for retail.
(d) Theatrical costumier's work—few designers work permanently in this field.

2. Imagination, creative artistic talent, business acumen.

3. Good general education, with abilities in art, needlework, French, and arithmetic an advantage. Some full-time courses demand higher standards.

4. Generally practical workroom experience, with part-time study.

ELECTRICAL ENGINEERING

1. Covers a very wide field—*e.g.* power generation and distribution, manufacture of heavy electrical plant for power stations, diesel electric locomotives, turbines, switchgear ; electrification of railways, trolley-buses ; installation of heating, lighting, refrigeration systems ; manufacture and maintenance of recording instruments and meters ; manufacture, installation, and repair of telephones and telegraphic equipment (telecommunications) ; radio and television manufacture and repair ; manufacture and installation of scientific and medical equipment, *e.g.* X-ray and infra-red apparatus.

2, 3, and 4. See ENGINEERING.

ENGINEERING

1. See other relevant headings.

2. Practical aptitude, mechanical interest, logical mind, mathematical ability, manual dexterity.

3. (a) For university qualification—G.C.E. " A "-level passes in mathematics and physics.

(b) For student apprenticeship—qualifications vary, usually (i) at 17–18, " A "-level passes in mathematics and physics, with " O "-level in chemistry and English ; (ii) at 16, at least 4 " O "-level passes, including English, mathematics, and a science.
(c) For craft apprenticeship—some ability in mathematics and English.
4. Training facilities also very varied :
(a) University course followed by practical experience, or—
(b) Part-time course at technical college as part of normal student or " sandwich " apprenticeship ; latter consists of several months' full-time study, alternating with similar periods of practical works experience ; or—
(c) Full or part-time study for Ordinary and/or Higher National Certificate, or for craft certificate of City and Guilds of London Institute.

FIRE SERVICE

1. Fire protection and extinction.
2. Minimum age 19, height 5 ft. 7 in. or over, good health and physique, practical ability, good head for heights.
3. No particular educational requirements.
4. Arranged by Service.

FLORISTRY

1. Selling, arranging, and displaying flowers.
2. Practical, creative, artistic ability. Unsuitable for anyone with sensitive skin.
3. No recognized educational requirements.
4. Informal apprenticeship, generally 3 years, or full-time course of 3–12 months at one of the few private schools of floristry. The Society of Florists arranges examinations.

FORESTRY

1. Cultivation of trees—planting, pruning, felling, etc.
2. Good health and physique, love of open-air life, self-reliance, leadership qualities.
3. Good general education with reasonable abilities in English and arithmetic for " forest worker " grade. Higher qualifications up to " O "-level G.C.E. standard required for " forester." University degree in Forestry required for appointment as " Forest Officer."
4. Full-time degree course and/or practical training as arranged by the Forestry Commission.

FUEL TECHNOLOGY

1. Production of fuels, mainly coal and oil (and by-products) for heating, lighting, power.
2. Practical, scientific aptitude.
3. G.C.E. " A "-level passes in mathematics, physics, chemistry, for university courses. " O "-level passes needed for apprenticeship training and study.
4. Full-time, " sandwich," and other part-time courses at university or technical college for Ordinary and/or Higher National Certificates, or City and Guilds of London Institute examinations.

GAS ENGINEERING

1. Design and construction of gas plant, research and maintenance—production, distribution, and using of gas power.
2, 3, and 4. See ENGINEERING.

GEOLOGY

1. Investigation of earth's surface by digging or boring for fossils, minerals, oils, etc.
2. Excellent health, vitality, scientific and practical aptitudes, self-reliance, and ability to work alone or in small groups, sometimes in remote parts, ability to pick up foreign languages.
3, and 4. University degree course essential.

HAIRDRESSING AND BEAUTY CULTURE

1. Cutting, shampooing, setting, waving, styling, etc. Beauty culture : face and skin treatment, make-up, manicure, etc.
2. Good health, ability to stand for long periods and work in humid atmosphere. Pleasant manner, good appearance and speech, some creative artistic ability and manual dexterity.
3. No particular educational requirements.
4. Three-year apprenticeship with part-time study or full-time course of training. Training in beauty culture obtainable at some few private schools. Girls advised to take up hairdressing first.

HEATING AND VENTILATING ENGINEERING

1. Design, construction, and maintenance of plant for heating and ventilating of buildings, mines ; control of temperature in factories, hospitals ; refrigeration techniques.
2, 3, and 4. See ENGINEERING.

H.M. FORCES

1. Numerous different occupations for women as well as men. Service in ranks or as commissioned officer in technical or non-technical branches in the Royal Navy, Army, Royal Air Force, Women's Royal Naval Service, Women's Royal Army Corps, Women's Royal Air Force.
2. Ability to mix and live with others under sometimes exacting and dangerous conditions, self-reliance, courage, common sense, initiative, readiness to accept discipline, good health, good physique, good eyesight.
3. Education requirements differ widely according to level and branch of entry.
4. Training in the Services, and, for commissioned rank, in appropriate colleges.
Further details can be obtained from the Admiralty, War Office, or Air Ministry.

HORTICULTURE

1. Growing of plants, fruits, flowers, vegetables, etc., for sale, public or private gardens ; advisory or teaching.
2. Patience, open-air type, good health, business acumen.
3. G.C.E. " O "-level passes in English, mathematics, chemistry, biology exempt from preliminary examination for National Diploma in Horticulture. For apprenticeships, good general education.
4. Full-time degree or diploma course at certain universities, colleges, and farm institutes. Women's Farm and Garden Association operates a training scheme for girls over 17.

HOSPITAL ADMINISTRATION

1. Organization and management of hospitals—secretarial, finance, supplies.
2. Administrative, organizing ability, sociability, ability to speak well in public.
3. G.C.E. " O "-level passes, 5 subjects, for registration as student member of the Institute of Hospital Administrators.
4. Practical office experience in hospital with part-time study for Institute's examination.

HOTEL AND CATERING MANAGEMENT

1. Arranging hotel services and management of clubs, restaurants, canteens—includes cooking, waiting, reception, clerical, etc.
2. Tact, patience, pleasant manner, well-spoken, good host.
3. G.C.E. " O "-level standard preferred, particularly English and arithmetic. Foreign language(s) an advantage.
4. Practical experience supplemented by technical college study or full-time course followed by practical experience. City and Guilds Certificates and other examinations available, some through the Hotel and Catering Institute.

HOTEL CHEF

1. Buying provisions, selecting menus, special dishes, sauces, etc., in hotels, restaurants, liners, airliners, hospitals, etc.
2. Patient craftsmanship, creative artistic ability, good health, ready to accept long working hours at holiday times and week-ends.
3. Good general education.
4. Preferably full-time training at a special hotel school or technical college.

HOTEL RECEPTIONIST

1. Reception, reservation, correspondence, some telephone operating of small switchboard, clerical work.
2. Pleasant voice, manner, and appearance ; tact, patience.
3. Good general education, neat handwriting ; some knowledge of typewriting, book-keeping, or a foreign language an advantage.
4. Short full-time courses arranged by Hotel and Catering Institute are available in a few districts ; otherwise training obtained as trainee in hotel employment.

INSURANCE

1. Recording, accounting, investing, drafting policies, and settling claims. Selling new insurance and collecting. Main branches : fire, marine, ordinary, industrial, life, accident

There is a greater demand for land surveyors overseas than there is in Great Britain. Training may be obtained by employment with the Ordnance Survey Department, the Oversea Civil Service, or with firms of civil engineers or surveyors, combined with instruction at a technical college. The surveyor on the left is in Tanganyika. Candidates for the colonial police forces (right picture) must be self-reliant, healthy, and possessed of initiative.

The Oversea Civil Service covers a wide range of appointments throughout the British colonies, and in many instances candidates must be in possession of a university degree. An agricultural officer will be responsible for the productivity of a district, and must introduce modern methods. The officer seen here is persuading natives of western Uganda to leave their impoverished fields to make a much better livelihood elsewhere.

2. Good appearance, confident manner, sociability, clarity of expression in speech and writing.
3. Most companies expect G.C.E. " O "-level passes in English language, mathematics, and 2 other subjects, for exemption from preliminary examination of the Chartered Insurance Institute. Mathematics to " A " level an advantage.
4. Office experience, with part-time study.

JOURNALISM
1. News gathering, preparation, and presentation in newspapers, magazines, etc. Selecting, revising, arranging, and rewriting (sub-editing), or specialist writing, *e.g.* sport, fashion.
2. Curiosity, excellent health to withstand exacting work at irregular hours. Sociable, good mixer, acute powers of observation, initiative, and originality, clarity of expression in speech and writing, gift of words.
3. National Advisory Council for training and education of Junior Journalists recommends G.C.E. " O "-level passes in minimum of 3 subjects, English language, English literature, and one other.
4. Part-time training as newspaper employee. Shorthand (up to 120 w.p.m.) and typing qualifications are advantages.

LAND AGENCY
1. Management of landed estates. Calls for a knowledge of agriculture, forestry, accountancy, law, construction and maintenance of farm buildings.
2. Love of country, sound judgment, good business acumen, sociability.
3. G.C.E. " O "-level passes in mathematics and English and 3 other subjects is minimum requirement of professional bodies.
4. Full-time university or College of Estate Management course of training, or a " pupilship " in a land agent's office, with part-time study for examinations of the Royal Institute of Chartered Surveyors or Land Agents' Society.

LIBRARIANSHIP
1. Cataloguing, classification, and circulating of books in municipal, university, or special libraries.
2. Interest in books and people, patience, good memory, organizing ability, a " tidy mind ", wide reading, clarity of expression in speech and writing.
3. G.C.E. " O "-level passes in 5 subjects including English language and one foreign language.
4. Practical training with part or full-time study for examinations of the Library Association. University graduates (with practical experience) preferred for senior appointments.

LOCAL GOVERNMENT SERVICE
1. Administration and organization of local public services, *e.g.* education, health, housing, police, libraries, municipal engineering. Treasurer's department—accounting, rating, salaries. Clerk's department—general oversight, co-ordination, legal services.
2. Personal qualities required depend on department entered—generally, a sense of responsibility to the public and loyalty to the authority.
3. Educational requirements also depend on field of work—G.C.E. " O "-level standard is a minimum for majority of appointments.
4. (a) Clerical : entry at 16–18, with part-time study for promotion.
(b) Professional and technical appointments : (i) entry at later age with specific (often university) qualifications and experience, *e.g.* Medical Officer of Health, senior appointments in education service ; (ii) some professional appointments acquired after internal experience and part-time study for specific qualifications, *e.g.* examinations of Institute of Municipal Treasurers and Accountants, Diploma of Public Administration.

MARINE ENGINEERING
1. Design, construction, installation, and maintenance of ships' machinery. Work with shipbuilding firm ashore or as sea-going engineer.
2, 3, and 4. See ENGINEERING.

MECHANICAL ENGINEERING
1. Design, manufacture, installation, and maintenance of machinery of all kinds, especially in industrial production, *e.g.* cars, foods, textiles, etc. All engineers need knowledge of mechanical engineering to some extent.
2, 3, and 4. See ENGINEERING.

MEDICAL LABORATORY TECHNICIAN
1. Assisting pathologist—testing, analysing, preparing material for examination, etc. Care of equipment.
2. Scrupulous attention to detail, accuracy, interest in hospital services.
3. For registration as student of Institute of Medical Laboratory Technology, G.C.E. " O "-level passes in English language, mathematics, chemistry or other science, and one other subject.
4. Laboratory experience supplemented by part-time study for Institute's examinations.

MEDICINE AND SURGERY
1. Maintenance of health, prevention of disease, diagnosis, treatment of mental and bodily illnesses or injuries.
2. Good health, patience, tact, confident manner, sense of vocation.
3. G.C.E. " A "-level requirements for university training.
4. Average of 5–6 years' training at medical school, followed by hospital experience.

MERCHANT NAVY
1. Sea-going deck work, navigation, catering, engineering, wireless.
2. Ability to live with others under restricted and sometimes difficult conditions, self-reliance, initiative, readiness to accept discipline, good health and eyesight, practical aptitude.
3. Educational requirements differ according to branch entered and whether entry is as a rating or as a cadet officer.
4. Sea-training schools, cadet colleges, certain technical colleges provide special training facilities. Wireless companies offer radio training. Many shipping companies employ apprentices with or without pre-sea training.

METALLURGY
1. Production and adaption of metals for industrial use—research and testing of hardness, lightness, resistance to heat, corrosion, etc.
2. Good health, scientific aptitude, clarity of expression especially in reports (because others usually have to be convinced of metallurgist's technical advice and instructions).
3. G.C.E. " A "-level mathematics, physics, chemistry.
4. Full-time university or technical college degree course or for qualification of Institution of Metallurgists, or 5-year apprenticeship in metallurgical works with part-time study for National Certificate in Metallurgy, or City and Guilds Certificate in Principles and Practice of Metallurgical Operations.

METEOROLOGY
1. Observing and recording of weather conditions and trends. Air Ministry appointments on shore stations, airports, weather ships, etc.
2. Good health and eyesight, accuracy, patient attention to detail ; readiness to work in any part of the country or abroad and accept " shift " work in watches.
3. Recruitment to Scientific Civil Service at three levels :
(a) Assistant (Scientific)—G.C.E. " O "-level passes in 4 subjects including English language and a mathematics or science subject ;
(b) Assistant Experimental Officer—" A "-level standard in similar subjects ;
(c) Scientific Officer—university degree or other high professional attainment.
4. Training arranged internally by Meteorological Office.

MUSIC
1. Teaching, performing, composing.
2. Love and appreciation of music, above-average skill as performer, determination, tenacity, and capacity for constant practice.
3. Good general education. Normal requirements for university degree in music or for teacher training.
4. Full-time training at certain universities, colleges, and schools of music ; also possible to study part-time at some colleges or with private teachers.

NURSERY NURSE
1. Care of healthy children up to 5 years of age in nurseries, orphanages, private households.
2. Genuine love of children, common sense, patience.
3. Good general education.
4. Training at approved training nursery or college ; study for Certificate of National Nursery Examination

Board. Similar training provided by Dr. Barnardo's Homes, National Children's Homes, Church of England Children's Society.

NURSING

1. Care of sick people.
2. Strong sense of vocation, responsible mature outlook, common sense, accuracy, patience, amiability.
3. Good general education. G.C.E. "O"-level standard with chemistry and biology an advantage.
4. Pre-nursing course training an advantage. Practical training in hospital with part-time study for State Registered Nurse qualification.

OCCUPATIONAL THERAPY

1. Helping sick people to recover by teaching and encouraging them to take up during convalescence some occupation which provides remedial treatment and interest.
2. Patience (particularly with the aged and mentally ill), strong sense of vocation, sociable, interest and good ability in arts and crafts.
3. Five G.C.E. "O"-level passes desirable, including English or history, a science, and a fine arts or crafts subject.
4. Three-year full-time training course at special training school; minimum age of entry, 18.

OPTICIAN (Dispensing)

1. Translating optical prescriptions into lenses and frames; mounting, fitting, and repairing.
2. Patience, accuracy, pleasant manner, manual dexterity.
3. G.C.E. "O"-level passes in mathematics, physics, or English for admission to the diploma course of the Association of Dispensing Opticians or Worshipful Company of Spectacle Makers.
4. Practical experience, plus part-time study.

OPTICIAN (Ophthalmic)

1. Eye specialist for prescribing of spectacles, fitting of contact lenses, artificial eyes, etc.
2. Confident and pleasant manner, accuracy, patience.
3. For entry to the qualifying examination of the British Optical Association—G.C.E. "O"-level passes in English, mathematics, a foreign language, and 2 sciences.
4. Three-year full-time course or a 4-year part-time plus 1-year full-time technical college course. Both must be followed by 1 year's practical experience before final qualification.

ORTHOPTICS

1. Treatment of squint and other eye defects, usually by means of eye exercises.
2. Teaching ability, sympathy (particularly with children), tact, pleasing personality.
3. G.C.E. with passes in 5 subjects, including English language, one of which should, if possible, be at "A" level. A pass in mathematics is advisable.
4. Two-year full-time training course at hospital for Diploma of the British Orthoptic Board.

PERSONNEL MANAGEMENT

1. Recruitment, selection, education, and training of staff; terms and conditions of employment, welfare amenities, joint consultation between employers and trade union.
2. Sociable, confident manner, able to win trust and respect, good organizing ability.
3. No specific educational qualifications, but a university or technical college background is desirable.
4. University degree or diploma in Social Science or Economics strongly recommended—preceded and followed by employment in industry.

PHARMACIST

1. Production and sale of medicines, drugs, medical and surgical appliances, toilet products, dispensing of prescriptions.
2. Methodical, accurate, sense of responsibility, confident manner, good eyesight (including colour vision).
3. For registration as student of the Pharmaceutical Society—5 subjects G.C.E. including English language, a foreign language, mathematics (2 of them at "A" level).
4. Three years' study at hospital or under practising pharmacist, followed by 1 year, as assistant, leading to diploma M.P.S., Ph.C. (Member of the Pharmaceutical Society, Pharmaceutical Chemist), the essential qualification.

PHOTOGRAPHY

1. Taking, developing, printing—portraiture, commercial and advertising (including fashion photography), scientific and industrial, medical, press, aerial.
2. Artistic ability, technical aptitude, resourcefulness, acute observation, good eyesight (including colour vision).
3. No specific requirements, but G.C.E. "O" level in English, mathematics, chemistry, and physics an advantage.
4. Training may be entirely practical, but most photographers take special training courses, full or part-time, for City and Guilds, or Institute of British Photographers, examinations.

PHYSIOTHERAPY

1. Massage, manipulation, remedial gymnastics, electrotherapy.
2. Good health and stamina, confident manner, sincere interest in rehabilitation.
3. Minimum for admission to training—G.C.E. "O"-level passes in 4 subjects including English language and a science (not biology).
4. Full-time 3-year training course; minimum age of entry, 18.

POLICE

1. Protection of life and property, prevention and detection of crime; street patrol, traffic duty, finger-prints, photography, motor patrol, control of aliens, etc. Women police have special duties with women and children.
2. Physical fitness, good character, acute observation, mature personality, and a sense of humour.
3. No particular educational requirements. Normal minimum height: 5 ft. 9 in. for men, 5 ft. 4 in. for women. Entry at age 19 (20 for women). Many police forces have cadet entry for boys aged 15½–16.
4. Training within the force or at Police College.

POST OFFICE ENGINEERING

1. Planning, provision, installation, and maintenance of telephone exchanges, radio and repeater stations. Development and testing of telecommunication equipment.
2. Mechanical aptitude, aptitude for mathematics and science, normal colour vision.
3. (a) Youths-in-training—"O"-level G.C.E. standard required, mathematics, physics, and chemistry desirable;
(b) Assistant Engineer—"A"-level science subjects (not biology).
4. Part-time study for City and Guilds Certificates in Telecommunication Engineering or for National Certificates or Engineering degree.

PRINTING

1. Composing, machine-minding, lithographic art work, bookbinding.
2. Neatness, accuracy, good eyesight (including colour vision). Compositors—good at spelling and punctuation, nimble-fingered. Machine-minders—mechanically inclined. Litho work—artistic ability.
3. No specified educational qualifications.
4. Apprenticeship training with part-time study at technical or art colleges for City and Guilds examinations.

PRODUCTION ENGINEERING

1. Planning of output, of production equipment and jigs, estimating and time-study in mass-production factories.
2, 3, and 4. See Engineering.

RADIOGRAPHY (Medical)

1. Medical X-ray work under supervision of qualified radiologist:
(a) Diagnostic, *i.e.* producing the radiograph;
(b) Therapeutic, *i.e.* administering treatment.
Also care of equipment, dark-room work, etc.
2. Good health, ability to handle people with sympathy.
3. Minimum requirement for admission to training school, G.C.E. "O" level in 4 subjects including English, mathematics, and a science.
4. Two-year full-time training course at a hospital school (minimum age of entry, 18) for examinations of Society of Radiographers.

RADIOGRAPHY (Industrial)

1. X-ray inspection of defects in materials, particularly metals.
2. Good mathematics, tenacity (because the work sometimes tends to be tedious and physically exacting).
3. No stipulated educational requirements: recruitment usually from laboratory assistants or trainee metallurgists for whom normal requirements are same as medical radiographers.

4. Practical experience, plus part-time or 2-year full-time course for industrial radiographers at certain technical colleges, and taking of City and Guilds examinations.

SECRETARIAL WORK

1. Shorthand-typing assistance to executive and administrative staff in all branches of professions, commerce, and industry.
2. Accuracy, methodical mind, resourcefulness, trustworthiness, pleasant manner.
3. Highest standard of general education possible, *e.g.* many secretaries are university graduates.
4. Full-time training course preferable; shorthand-typing experience essential before applying for secretarial appointment.

SOLICITOR

1. Confidential adviser, executorship, drawing-up of wills, purchase and sale of property, pleading of cases in lower courts, preparing briefs for barristers.
2. Same as for BARRISTER.
3. Minimum requirements for exemption from preliminary examination of the Law Society—5 G.C.E. "O"-level passes, including English, history, and Latin. Normal university entrance requirements for a degree course in Law.
4. Five-year articled service to a practising solicitor with concurrent study for Law Society examinations, or university degree in Law.

SPEECH THERAPY

1. Treatment of speech defects, particularly those found in certain children.
2. Good clear speech, with good ear for speech sounds, a liking for children, sympathy, patience.
3. G.C.E. with minimum of 5 passes including English language, 2 preferably at "A" level. Knowledge of English literature, physics of sound and music, and biology also an advantage.
4. Three-year full-time course for Licentiate of the College of Speech Therapists.

SURVEYING

1. Very wide range—land agency, valuation, estate management, building, town planning, mining and land surveying.
2. Accuracy, neatness, skill in technical drawing.
3. Good general education. Requirements differ for various professional bodies, but G.C.E. "O"-level standard in 4–5 subjects including English language, mathematics, and geography usually needed.
4. As pupil or technical assistant with part-time study, or full-time degree course for professional examinations of Royal Institution of Chartered Surveyors, the Incorporated Association of Architects and Surveyors, or the Institute of Quantity Surveyors.

TEACHING

1. "Qualified" teachers are eligible for posts in all schools, but the majority specialise in age groups in primary (junior) schools or in particular subjects in secondary schools, colleges of further education, etc.
2. Patience and a sense of vocation.
3. Minimum requirement for entry to training college—5 passes "O"-level G.C.E. Normal university entrance requirements for degree courses.
4. For non-graduate teachers, normal training is 2 years; minimum age of entry, 18. Special courses, *e.g.* domestic science or physical training, may extend the course to 3 years. Intending graduate teachers are well advised to take post-graduate Teacher Diploma Course or Diploma in Education.

VETERINARY SCIENCE

1. Diagnosis, prevention and cure of animal diseases, care of health of livestock; inspection, research.
2. Good health and physique, understanding of animals, scientific aptitude, some business acumen if in private practice, confident and pleasant manner.
3. Normal university entrance requirements—chemistry, physics, biology.
4. Full-time 5–6-year university course.

Telegraph Condenser Co., Ltd.

Engineers rely on drawings to express their ideas precisely, whether designing a product or a tool, or explaining how they wish certain work to be done. The engineering draughtsman receives technical training at a school, and, besides skill at drawing and considerable mathematical ability, should have a wide knowledge of processes, materials, and mechanisms. Later the right type of man may become a designer, and finally leave the drawing-board to undertake costing, estimating, or the supervision of an associated department.

Caribbean Sea. The name of this sea brings to mind the 16th-century pirates and buccaneers who attacked the shipping of the Spanish Main—the waters north of Colombia and Venezuela. Now, apart from the Panama Canal traffic, it is traversed chiefly by ships that convey the sugar, coffee, cacao, and bananas of the tropics to the United States and take back manufactured goods in exchange.

Named after the Carib Indians who once lived on its islands and shores, the Caribbean Sea is a great arm of the Atlantic Ocean, 750,000 square miles in extent and enclosed by the eastern coast of Central America, the north coast of South America, and the long, sweeping crescent of the West Indies. The greatest breadth, from Cuba to Panama, is about 900 miles; length, from Yucatan to Trinidad, 1,750.

The sea is comparatively free from rocks and reefs, except near the islands, but frequent hurricanes take great toll of shipping. These storms are caused by the over-heating of the warm waters of the Equatorial Current, which sweep across the Atlantic from Africa, remain pent up in the Caribbean, or slowly make their way through the Yucatan Channel—120 miles wide—into the Gulf of Mexico, and thence through the Florida Strait and northward as the Gulf Stream. As the hot air above these waters rises, the cold northern and eastern trade winds rush in with tremendous force, and cause widespread destruction.

The bed of the Caribbean Sea is a vast submarine mountain system. The easternmost chain rises above the surface of the waters to form the West Indies archipelago. Nowhere else are there such contrasts of ocean depth within such short distances. Long ridges approach the surface and then fall away on both sides in submarine precipices three miles deep, the greatest depth being 24,000 feet. From these abysses strange and outlandish creatures are often brought up by dredging, some closely resembling fossil forms long extinct.

Gambier Bolton

CARIBOU, LARGEST REINDEER

The wild reindeer of North America is called the caribou (derived, some say, from *carré boeuf,* square ox). Both male and female possess antlers. The northern woodland caribou, shown in this picture, is the largest species.

Caribou. The wild reindeer of North America (*Rangifer caribou*) is well known as the caribou. The body is heavy, and the powerful legs end in large, broad, spreading hoofs, adapted to secure firm footing on marshy ground. Big, irregularly-branching antlers are borne by both sexes, but the antlers are smaller and more slender in the females.

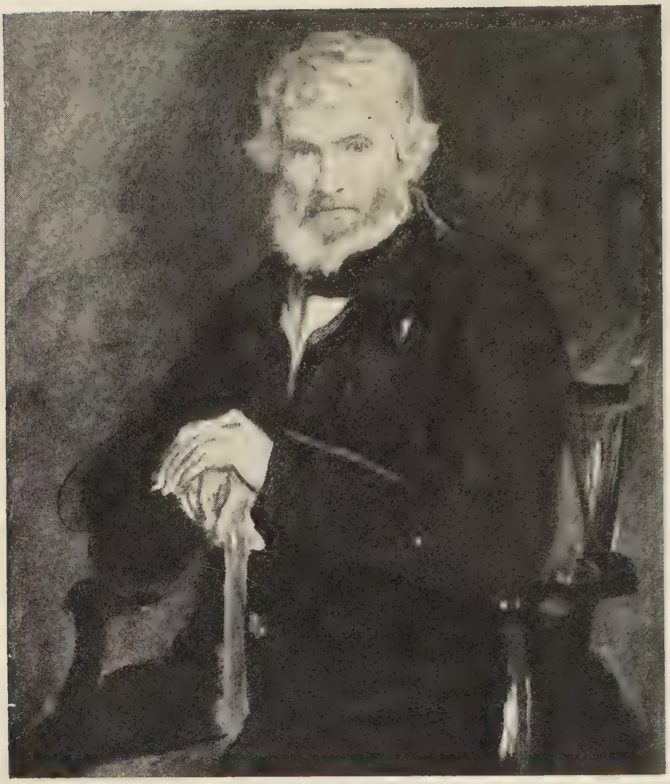
There are two kinds of caribou in North America. The woodland caribou is confined to the forest areas from Alaska and Labrador down to northern Maine, but it has been much reduced by hunting and the only United States herd is now found in a national park in the Lake Superior district. This kind feeds on leaves, grasses, and aquatic plants, but especially on lichens. The barren-ground caribou is smaller and paler, and it lives in the desolate country north of the tree line. The huge herds that once existed have been much reduced in size and range.

Caribou make tremendous migration journeys in spring and autumn to find suitable feeding, and some tribes of Eskimos depend mainly on caribou for their living. Unlike the reindeer of northern Europe, the caribou has not been domesticated.

Carlisle. Many commanders of earlier centuries had laid siege to the historic city of Carlisle before the Young Pretender came with his "hundred pipers an' a', an' a'" in 1745—though he was the only one to march in without a fight. Lying only 10 miles from the Scottish border, the county town of Cumberland has had a stirring history, recorded in many ballads and tales as well as in more formal annals. It stands in a small plain where the river Eden is joined by the Caldew and the Petterill, at a place where a fortress was almost bound to develop. To the west is the Solway Firth, and to the east the Tyne Gap between the Cheviots and the Pennines.

There was a Celtic settlement here even before Agricola came in A.D. 78 and built the Roman town of Luguvallium. Later the Roman Wall ran north of the town. The Romans left, and Carlisle became a British city. The only town on English soil with a purely British name (*Caer-Luel*), it is associated with the legends of King Arthur. The Danes sacked the city in 875, and 70 years later Cumberland was ceded to Scotland. Thereafter Carlisle remained Scottish until William Rufus reclaimed it in 1092 and began to build the castle and the priory church that later became the cathedral. The city was seldom peaceful. The Scots attacked it many times, and David I of Scotland seized it in 1135. Edward I made it his headquarters for his Scottish wars, and held parliament there. In the Civil War it was besieged for nine months (1644–45) before surrendering to General Leslie.

Carlisle is now an important rail and road-transport centre. It is renowned for its biscuits, and other manufactures include hats and textiles. Since 1916 its public houses have been under state



THOMAS CARLYLE

A hater of sham and hypocrisy, Thomas Carlyle helped to mould opinion during the 19th century. The son of a Scottish stonemason, he received an excellent education; and after starting life as a schoolmaster he turned to a literary career. This portrait by the British artist Millais (1829–96) is in the National Portrait Gallery, London.

control, and run on a café system with tables instead of standing bars; but this "Carlisle experiment" has not proved sufficiently popular to be extended to other towns. Besides the castle (now used as a barracks), the cathedral (where Sir Walter Scott was married in 1797), and the Roman remains, the city's many interesting buildings include an ancient grammar school, a market cross, and a museum and art gallery. The population in 1951 was 67,894.

Carlyle, Thomas (1795–1881). The schoolmaster son of a Scottish stonemason, harassed for much of his life by poverty, irritated by chronic indigestion, angry with the times he lived in, came in the end to be regarded by many as the greatest historian, essayist, and philosopher of his day and would now lie among the mighty in Westminster Abbey had he not wished his remains to be buried in the Dumfriesshire village of Ecclefechan, where he was born. Yet within 50 years of his death his writings and his philosophy had come to be generally disregarded, and to-day, though his influence remains, he is read by very few. The style of his writings is difficult, full of strange, rugged, distorted phrases, wild outbreaks of passion and fury, and disturbing tricks of punctuation and grammar; it reflects the nature of the man, eccentric in manners, a violent hater of all sham and falsehood, eloquent but gloomy, whose humour was mostly sarcasm, and whose friends were few and had to be forbearing.

Carlyle hated poverty and preached the need for revolution, but he had no faith in democracy or the average man; he worshipped the Great Man, the leader and dictator ("I say great men are still admirable; I say there is, at bottom, nothing else admirable.") His was the gospel of hard work and struggle ("Whatsoever thy hand findeth to do, do it with thy whole might. Work while it is called To-day; for the Night cometh, wherein no man can work.") His historical writings bear out his beliefs; in his *French Revolution* (1834–37), possibly his greatest work, he glorifies the leader rather than the masses. His *Heroes and Hero-Worship* (1841) expresses the same idea, and his own heroes were two dictators: Oliver Cromwell, subject of his *Letters and Speeches of Oliver Cromwell* (1845), and Frederick the Great, of whom he wrote a huge biography (1858–65). The effect of this philosophy on politics was undoubtedly bad, and it had not a little to do with the development of Fascism, Nazism, and single-party Communism in the generations following Carlyle's.

Intended for the ministry, he was educated at Annan and Edinburgh University, and became a teacher of mathematics and later a private tutor to a wealthy man's son. His first and abiding literary interest was German thought, and his early works were essays on German poets and translations of German works. At that time few Englishmen knew German, and German literature was a closed book in England: Carlyle's work was thus of great importance in introducing English readers to Goethe, Schiller, Richter, and other German authors. No doubt his German studies also helped to form his own involved style, as well as his feeling of admiration for great men—a typical German sentiment.

In 1826 Carlyle married the charming, beautiful, and talented Jane Baillie Welsh. From 1828 to 1834 they lived in a moorland farmhouse at Craigenputtock, "the loneliest nook in Britain, six miles removed from anyone likely to visit me." Here Carlyle wrote *Sartor Resartus* (1833–34), a strange, furious, muddled series of essays in which a life philosophy is hung on the history of clothes. Here his individual style was first seen, and here he describes some of his early struggles. In 1834 the Carlyles moved to No. 5 (now No. 24) Cheyne Row, Chelsea, London, the house which will always be associated with them and which is now a Carlyle museum. It was to this house that one morning the philosopher John Stuart Mill rushed in agony with the news that the manuscript of the first volume of Carlyle's *French Revolution*, which he had sent to Mill for his opinion, had been used by Mill's servant-girl for lighting his study fire. Carlyle, who took the news with calm and seemed

more upset by Mill's distress than his own loss, set to and re-wrote the volume, although it took him a year to do it.

Jane Welsh Carlyle died suddenly in 1866. Her life had been made difficult by her husband's bad temper and fits of despair ; but their affection was true and deep, and Jane was Thomas's chief source of inspiration. After her death he wrote no important work, except his *Reminiscences*, published soon after his death, which occurred in 1881, in his 86th year.

Carmarthenshire. With an area of nearly 920 square miles and over 171,000 people, Carmarthenshire, in south-west Wales, is the largest of the Welsh counties and third in order of population. Its Welsh name is Sir Gaerfyddin. Much of it is lowland, through which flows its chief river, the Towy, but to the south-east are the Black Mountains, rising to a height of over 2,000 feet. This mixture of hills and lush valleys makes it a rich pastoral country. Carmarthen, the county town, was famous as a wool centre in the Middle Ages, and for many years past Carmarthen dairy cattle have provided London with much of its milk. The only industrial centres are on the anthracite coalfield in the East, the chief of them being the steel and tinplate town of Llanelly. The county's links with the past go back thousands of years before Christ. Its first invaders—Mediterranean seafarers—left behind great stone monuments (cromlechs) and sepulchres in the earth (dolmens), numbers of which can be seen to-day, and many relics of the Bronze Age and, nearer the present time, of the Roman occupation have been found. Later times are recalled by the ruins of a chain of Norman castles. In the coracle—a flimsy, basket-like, fishing-boat—present-day Carmarthen has a direct link with the ancient Britons (see illustration under article WALES).

Carnarvonshire. *See* CAERNARVONSHIRE

Carnation. The earliest carnations brought to England by the Romans were probably like those still growing wild in southern Europe, with single flesh-pink flowers. The Latin " carnis," meaning flesh, was the source of the name. The scientific name *Dianthus*, which includes pinks and sweet-williams, comes from the Greek name given to the flowers by Theophrastus, and means " divine flower." Carnations belong to the family *Caryophyllaceae*, and have the characteristic narrow paired leaves and swollen stem joints of the family, as well as the deep jug-shaped calyx. Their scent is due to tiny drops of clove oil in the petals. As with many kinds of flower, cultivation has enormously increased the number of petals and the variety of colours. Those with flowers of one colour only (white, yellow, pink, or red) are called self-coloured. Those with streaks of a second colour are called " flaked," those with streaks of two different colours on the main colour are " bizarre," and those with a fringe of deeper colour at the edge of their petals are " picotee." New varieties are produced only from seeds, and the more " double " the flower the fewer are the seeds obtained from it. The plants are propagated (multiplied) by cuttings, or by layering—cutting half-way into a joint and pegging the partially severed stem into a bed.

The term carnation is usually kept for the tall-stemmed variety *longicaulis* of *Dianthus caryophyllus*, but single kinds of this are often called pinks. The name pink is used for short-stemmed kinds of *Dianthus plumarius*, *D. chinensis* (Indian pink), and others—most, but not all, having single flowers.

Carnegie, ANDREW (1835–1919). If Andrew Carnegie were the hero of a story or a film, you would probably think the plot " too good to be true." Many other poor boys have become famous as millionaires, but Carnegie is best remembered for giving his fortune away.

He was born in a cottage in the Scottish town of Dunfermline, where his father worked at a hand-loom and his mother made shoes. At that time, just over 120 years ago, industry was being rapidly changed by mechanical inventions, especially in cloth-making. Power-looms needed fewer workers, and, fearing unemployment, Carnegie's father took his family to America in 1848.

They settled in Pittsburgh, Pennsylvania, and there young Andrew, now thirteen, began work as a bobbin-boy in a basement cotton-mill. To make up for his small education he read ravenously and joined a debating society, and soon became a telegraph messenger, then a clerk. Later, working for a railway company, he invented a sleeping-car. This was so successful that he was able to launch his own company, with the object of replacing old-fashioned wooden bridges by metal ones. These were the first iron bridges over the Mississippi, Missouri, and Ohio Rivers. Carnegie developed scheme after scheme and became immensely rich, owning a steel plant, oil and iron fields, railways, and steamers. But in 1901 he sold up for £100,000,000 and returned to Scotland to spend his wealth for the benefit of others.

The Carnegie Trusts manage his vast fortune, covering such varied interests that many people are touched by them without even knowing it.

In America, Carnegie provided pensions for his workers, aided Negro education, and established an institute for scientific research. He created a special Dunfermline Trust for his birthplace, and his United Kingdom Trust did much for Scottish universities, beside founding or assisting museums, public libraries, and welfare centres all over Britain. Its reports are valuable social documents.

The Trust publishes music by living composers who would otherwise be unknown. It has also helped the Old Vic and Sadler's Wells theatres in London, and has restored or rebuilt many church organs. Various endowments exist to encourage international peace and to create closer understanding between English-speaking peoples.

When Carnegie died, his gifts totalled some £70,000,000, and the great work still goes on. He indeed lived up to the belief that he expressed : " He who dies possessed of wealth that he was free to distribute, dies disgraced."

Carolina. As a district of North America colonised in the reign of Charles I, Carolina took its name from him (the Latin for Charles is Carolus). In the reign of his son it was divided into North and South Carolina.

These now form two separate states of the U.S.A., both facing south-east on to the Atlantic. Virginia lies to their north, Georgia to their south,

LAKE HIGH UP IN THE CARPATHIAN MOUNTAINS

The Carpathians extend for some 900 miles between Czechoslovakia and Rumania, and the central section, which is partly in Poland and partly in Czechoslovakia, is called the High Tatra. The lake seen here is in the High Tatra at an altitude of 4,000 feet. Some of the highest peaks of the whole system are situated in the central portion which culminates in the Gerlsdorfer Spitze (8,740 feet in height). Forests cover the lower slopes of the mountains.

and inland lie the Blue Ridge mountains, running through Georgia, Tennessee, and Virginia.

The principal products are cotton and tobacco. Charleston (originally Charles Town, after Charles II) is an important seaport in South Carolina. Its population in 1950 was 70,174. The administrative capital of North Carolina is Raleigh (65,679), and of South Carolina, Columbia (86,914, the largest city in the state). The population of the northern state was 4,061,929 in 1950, and its area 52,712 square miles. South Carolina has 2,117,027 people in an area of 31,000 square miles.

The history of these states, two of the original 13 United States, has been very eventful. In the year 1584 an expedition sent out by Sir Walter Raleigh explored the Carolina coast of North America. In the following year a colony settled on Roanoke Island, but conflicts with the Indians soon led the settlers to return. The region was properly colonised under a grant from Charles I. In 1663 Charles II granted it to a group of aristocratic proprietors, who divided it into North and South Carolina. North Carolina, in 1776, was the first to vote for independence against England, and both the Carolinas saw bitter fighting during the American Civil War of 1861–65. North Carolina joined the Confederacy (the Southern states) after Fort Sumter, in South Carolina—a Confederate state from the beginning—had been bombarded by the Union troops in 1861. A more recent historic event in North Carolina was the first real aeroplane flight—by Orville Wright at Kitty Hawk in 1903.

Agriculture is the chief occupation of these states, and cotton, tobacco, and peanuts are valuable crops. North Carolina makes cigarettes, textile goods, and furniture. Both states have large Negro populations.

Carp. This is one of the best known and most widely distributed of all fresh-water fishes. It is the typical fish of the family *Cyprinidae*, to which belong the greater number of English fresh-water fishes. Brought to Europe from China and introduced into Britain in the 15th century, the carp was one of the favourite fishes of the monastery ponds. It lives to a great age, and may grow to a great size. The biggest caught in Great Britain so far weighed 44 lb., but weights up to 100 lb. have been recorded on the Continent.

The common carp, *Cyprinus carpio*, which lives in sluggish canals or lakes and ponds, is one of the angler's greatest prizes, for it is very hard to catch. Others of the carp group are the goldfish, dace, roach, tench, chub, and minnow.

Carpathians. The magnificent arc of towering peaks, rolling wooded hills, and deep valleys of the Carpathian Mountains almost surrounds the fertile plains of central Europe, stretching for about 900 miles from the north of Bratislava (Pressburg) in Czechoslovakia through Poland and Russia to Orsova in Rumania. The lower slopes are covered with giant pines. Some of the peaks are more than 8,000 feet high (the highest being the Gerlsdorfer in the High Tatra in Czechoslovakia, 8,740 feet); but averages run much lower.

Snow covers the higher summits for about nine months of the year. On some of the mountain tops are small salt lakes. In the forests roam bears, wolves, and lynxes; and eagles and other birds of prey are common. Minerals are abundant.

A TRIUMPH OF THE HORTICULTURIST'S ART

Despite the tremendous size of individual blooms, this type of carnation has everything : daintiness of petal and colouring, superb form, and perfume that places it in a class apart. Even when the flowers have had their day, the plants are strikingly attractive, the strong grey-green foliage never failing to catch and hold the attention. This big bloomed, pot-grown carnation tests the greenhouse-owner's care and skill to the utmost.

THE PERFECT BUTTONHOLE FLOWER

Millions of carnation plants are grown under glass in England to provide blooms perfect in shape, size, colour, and perfume for florists' shops at all seasons of the year. Numerous outdoor varieties of modern introduction now almost rival the beauties grown in greenhouses. The carnations brought to England by the Romans had probably single flesh-pink flowers, similar to those seen growing wild in plenty in parts of southern and central Europe.

COMFORT *and* BEAUTY UNDERFOOT

Carpets and Rugs. In 1953 some Russian scientists excavating a Scythian tomb in far-away Outer Mongolia discovered a carpet perfectly preserved in a perpetual frost under a pile of stones. The horses, horsemen, and stags, in deep reds on a yellow ground, are still fresh and bright. This takes the story of carpets back some 2,400 years. Moreover it is made in exactly the same way that hand-knotted carpets were made in the succeeding centuries. How the original owner used it is not known, for carpets and rugs have served many different purposes all over the world. The original meaning of " rug " is simply a coarse covering (from Swedish *rugg*, a mass of rough, tangled hair).

Primitive tribes probably used felts, wool matted together but not woven, to produce a thick, warm, but not very hard-wearing fabric. Hand-knotted rugs have been used as bed-coverings. The Finns, especially, made double-sided woollen pile rugs called ryas, which were some of the warmest coverings ever devised. Wandering nomad tribes used their rugs as cushions, bags, doors, and wall coverings to keep the cold winds out of their tents. Camel-bags, table-covers, decorative wall-hangings, have all been made from rugs. One special kind made in Mahomedan countries is the prayer-rug, mostly quite small, with a pointed niche at one end which the owner points towards Mecca when he lays it on the ground to kneel upon while he says his prayers.

The everyday rugs have long ago worn away, but in the world's great museums are preserved rugs and carpets of the highest quality, carefully guarded throughout the centuries and still giving wonder and delight to-day. The signed Ardebil carpet, made for a mosque in 1540 by a slave of the temple, is one such treasure now in the Victoria and Albert Museum, in London. It is possibly the largest carpet in the world.

The methods of making hand-knotted rugs are quite simple. Threads called warp threads are stretched from a rigid beam and either weighted individually at the other end or tied to another beam. A few rows of another thread, called the weft, are interlaced with these at one end and beaten down. (*See* Loom for detail of interlacing technique.) Knotting can then begin. The illustrations show how the different kinds of knot are tied around the warp threads. If you pass your hand down the pile of a hand-knotted rug, you will feel it give in one direction, which shows which way up the rug was made, for the weaver always knots towards himself. He ties one row of knots, and then passes one or more shoots of weft across before the next row, beating the fabric down after every shoot. This process makes a tight, strong fabric quite unlike the hooked rugs made on canvas by hand to-day. The number of knots to the square inch can vary very greatly from about 16 to over 300. (The carpet from Ardebil has about 340 to the square inch.) The fewer the knots, the more quickly the weaver can work.

The warp threads are made from wool, cotton, or linen, the wefts may be of wool or cotton and the pile of wool (sheep and sometimes goat), and in many countries white cotton is used for the white parts of the pattern. Some very fine rugs are knotted on silk warp threads with a silk pile. " Soumak " and " Kilim " rugs are woven without pile, the one using a kind of back-stitch and the other a tapestry weave. Until the middle of the 19th century dyes were made from traditional recipes producing handsome colours that mellowed gracefully as the rugs grew older. Cheaper aniline dyes from the West upset the traditional colours and led the European importers to tone down the harsh colours they produced by washing the rugs in chemicals. This weakened the rugs and set a fashion for faded, mock-old colour schemes.

The names of the countries where carpets and rugs were first made have changed as invaders have conquered and re-conquered the lands for 2,000 years. Looking across the map from west to east,

Wilton Royal Carpet Factory Co., Ltd.

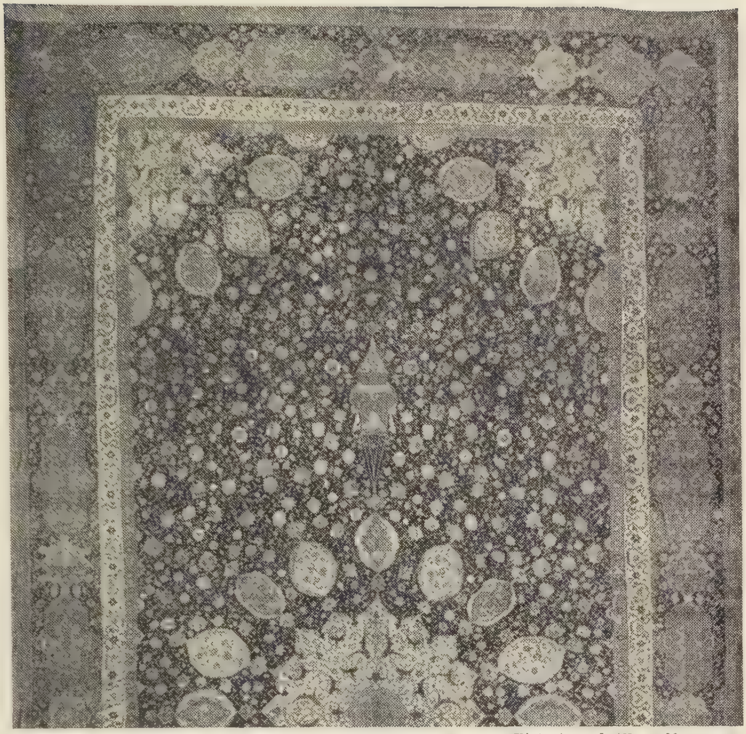
TYING A TURKISH KNOT

In the Near East, and to a very small extent in the United Kingdom, carpets are woven on simple hand-looms, and every knot is tied by hand. In the Turkish knot both ends of every tuft of yarn are brought through together between every two threads of the warp.

WEAVING A WILTON PATTERNED STAIR-CARPET

Wilton Royal Carpet Factory Co., Ltd.

The Wilton-type carpet is a development of the loop pile Brussels. The pile is of woollen or worsted yarn running parallel to the warp. A Wilton carpet is usually made with five colours, and the colours are automatically selected by the Jacquard mechanism, which can be compared with the perforated paper roll of a pianola and is visible at the top of this picture. The four coloured yarns not showing at any one place are woven into the back.



Victoria and Albert Museum

MASTERPIECE OF A PERSIAN CRAFTSMAN

Made in about 1540 by Magsud of Kashan for the mosque in Ardebil, Persia, this magnificent carpet is richly and delicately coloured, with a predominantly dark blue background. It was woven by a slave, who signed his work. Possibly the largest surviving carpet of its kind in the world, it measures 34 feet 6 inches in length, and 17 feet 6 inches in width.

the countries which have made carpets for centuries are Asia Minor (Turkey), Persia, the Caucasus, the lands south of the Aral Sea where the Turcoman tribes live, Baluchistan, Pakistan and India, Turkestan, and China itself. Cold, mountainous areas where warm coverings are a necessity, good pastures for sheep, and hence good quality fleeces, are common to all. As peoples migrated and traded with one another they brought their crafts with them. Thus the weavers who tie the Turkish knot, for example, and those who use the Persian, live not in neighbouring countries but often in neighbouring villages. The caravan routes across Central Asia, Persia, and through Asia Minor to the ports of the Levant, brought textiles and other precious things from the Far East to the lands of the Mediterranean and so to Europe. Thus in Persian carpets one can see typically Chinese patterns such as the cloud-band (diagram in col. 2), and in early Spanish carpets one finds the geometrical shapes of the rug patterns of Asia Minor.

Apart from a few fragments, there is a gap of nearly 2,000 years between the Pazyrik and the next surviving complete carpet. It is known that carpets were made at that time, particularly in Asia Minor. When Edward I brought his new queen, Eleanor of Castile, to England, in 1255, Spanish rugs were hung from the windows of the streets of London to celebrate the occasion. Paintings down the ages show what some early rugs looked like; and often Italian pictures present the Virgin seated on a throne whose steps are covered with some Near Eastern carpet. From the early Middle Ages, Venice was one of the great trading centres of the world, and so carpets came to Italian cities from the East. One variety of Anatolian carpet (a district in Asia Minor), usually red and yellow, is so often seen in the paintings by Hans Holbein (see article, and frontispiece to this volume) that it is called a "Holbein" carpet. Many different kinds of pattern grew from this one, and it was among the first to be copied by European weavers. From the 17th century Turkish carpets often copied Persian designs, but the graceful flowers of the latter became more geometrical.

Probably the most beautiful Persian carpets date from the 16th and 17th centuries. Rich, deep colours carefully blended, very fine knotting, and elaborate designs whose detail never overwhelms the total effect, are their outstanding qualities. One type of carpet is called a "hunting" carpet because among the intertwining flowers are leopards springing on their prey or huntsmen on horseback with spears or bows and arrows. Another most attractive type is the "garden" carpet, with trees, flowers, and streams and sometimes animals. These carpets were copied again and again in Persia itself and imitated by Turkish weavers. Carpets were made in India for the court of the Mogul emperors by Persian weavers, and they look much like Persian carpets, although Indian ones sometimes include houses, men, and animals.

The first European carpets were made in Spain, with the use of a special knot. At first copying the patterns of Asia Minor, Spanish weavers soon began to make up their own designs. In England Henry VIII was probably the first king to import carpets on a large scale, pestering Cardinal Wolsey to get them from the East, and importing 60 from Venice in 1520. Since they were so precious, these carpets were more frequently used as coverings for tables than for floors. Carpets and rugs were rare throughout the 16th century, and rushes continued to be used on the floors, even at court. Some fine carpets were made in England at the end of the century, with Near Eastern patterns but embroidered on to a previously woven canvas. Knotted carpets were called "turkey work," and cushions patterned with coats of arms and the fresh flowers of the English fields, were made in the 17th century, but not many carpets of any sort were made in England until the 18th century. The

Chinese cloud-band pattern.

STRIP OF CARPETING PASSING UNDER THE SHEARER

Wilton Royal Carpet Factory Co., Ltd.

This machine-made carpeting is being automatically fed into the shearing machine, which will make the surface even. The cutting mechanism is hidden by the metal plate. Wool is the principal material used in most carpets, and generally forms the pile. The denser and deeper the pile, the more luxurious is the feel of the carpet. The carpet industry has developed into a many-sided craft, employing artists, chemists, engineers, spinners, and weavers.

SIMPLE RUG AND FLAMBOYANT WOOLLEN CARPET

This is a tent-bag (a Juval) made by a weaver from one of the Turcoman tribes of Central Asia in the 18th or 19th century. Most of the carpets and bags made by these tribes are very finely knotted, very strong, with rich colours and patterns rather like this. The nomad tribesman kept his belongings inside, and it was easily carried.

This is part of a large hand-knotted, colourful carpet made by a French refugee named Passavant, at Exeter, who employed English workmen. This carpet, which has its date (1757) woven into the border, is an example of the work of the mid-18th century to match the furnishings of the time. It is in the Victoria and Albert Museum.

Woodward & Grosvenor, Ltd.

ENGLISH CARPETS BEARING NAMES OF WORLD-WIDE RENOWN

The names of two English towns have long been linked with carpets : Wilton in Wiltshire, and Axminster in Devon. Both types, however, are now made at Wilton. The Wilton is a development of the Brussels, and on the left is a " Persian " design on a thick-piled Wilton. Axminster carpets are of many kinds, that on the right is one with a simple pattern

competition from carpets imported by the great merchant companies, the Levant and the East India Company, was too strong. Even in the 18th century the first attempts by certain Frenchmen to found factories in England were unsuccessful and the founders went bankrupt.

Prizes were offered by the Royal Society of Arts to encourage the industry. In 1756 these were won by Thomas Moore of Moorfields, and Thomas Whitty of Axminster. Both prospered, and Thomas Moore worked for the fashionable architect and designer Robert Adam (see article) producing carpets to his designs to match his interiors. In France the most important workshop to be founded was the Savonnerie (1626), so-called because the workshops were housed in a building that had been a soap factory. Nearly 50 years later the royal workshops at the Louvre, the French royal palace in Paris, were joined to the Savonnerie factory, and a series of large, splendid carpets were produced, with designs that matched the furniture of the time and owed nothing in pattern to Eastern carpets. In the 19th century the factory united with the Gobelins tapestry works, but continued its original work of making carpets.

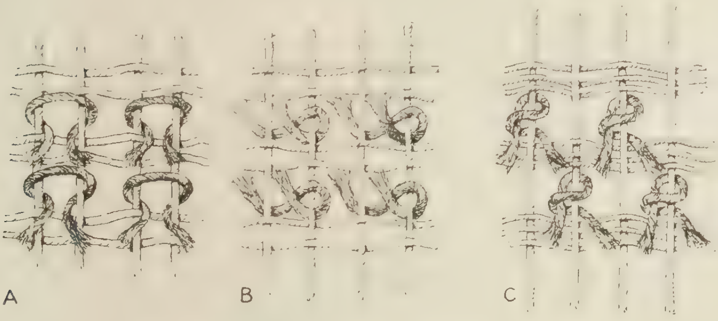
PERSIAN CARPET-WEAVERS

On this type of hand-operated loom are woven many of the rugs and carpets made in the Orient. The two weavers are copying an intricate old pattern, but each usually adds some personal touches, so that two rugs of the same design are rarely exactly alike.

All these enterprises made carpets for the very rich, but by the 18th century there was a demand for comfortable floor coverings from those with moderate incomes. Carpets woven like other cloths, but not knotted, were made in the 17th century, and by about 1735 the towns of Kidderminster and Wilton were in active competition. There were several methods of weaving, but to produce a complicated pattern was still very expensive. The invention of the Jacquard loom (see article), whereby the warp threads are controlled individually but mechanically, changed the character of carpet making. It was first used extensively at Kidderminster from 1825. Patterns as varied as those of hand-knotted carpets could thus be produced, and much more cheaply.

The mechanisation of the carpet industry followed the course of the rest of the textile industry. Steam power increased the speed of production, and jute backing reduced costs. In 1839–40 a method of printing the warp before weaving was devised and in the same period chenille thread (a furry thread woven in strips on a loom) was applied to carpet making. Broader carpets with thicker, better pile were made. Later in the century the "spool Axminster" and the "gripper" (by which a thread of the correct colour is selected by a Jacquard machine and inserted mechanically) brought on to the market really satisfactory machine-made carpets, colourful and hard-wearing. A method was even devised of tying by machine a knot identical with the Turkish knot. Latex-backed rugs with the pile sunk in rubber have led to the production of cheap, mostly plain-coloured, carpeting since the Second World War.

While the first machine-woven carpets were appearing in Europe, magnificent hand-knotted rugs were still being made in the East. Richly coloured rugs from the Caucasus were imported until late in the 19th century. From the Turcoman tribes came sumptuous rugs chiefly of rich, deep reds, a rather special pattern, and a highly lustrous texture. From China came carpets, some of them silk, with the dragons, vases, plum-blossom, and lucky symbols found in every Chinese work of art. In many Chinese carpets the outline around the important parts of the design is clipped in the pile by the weaver. The carpet-making districts of Persia have sent carpets to Europe until the present day, made according to their old local traditional



THREE WAYS OF TYING WEAVERS' KNOTS

Three kinds of knot are used in hand-made carpets. A: Turkish or Ghiordes knot. B: Persian or Sehna knot. C: Spanish or Single Warp knot. In each instance the vertical threads are the warp, and the horizontal ones form the weft. The knots would actually be tied much more tightly.

designs, some most pleasantly. In India, too, old Persian designs have been copied, sometimes in cotton, to produce cheap and adequate floor coverings, if not great works of art.

To-day the machine has ensured that the carpet is not a luxury for the very few, but carpets can be found as closely following contemporary taste as did those made by Thomas Moore for Robert Adam in the 1760s. From the bedside rug made in India to the carpeted foyer of the large hotel one can appreciate its comfort. The fingers of the nomad weaver long ago and the powerful machines of the 20th century have brought great comfort and delight to humanity.

Carroll, Lewis (1832–98). Charles Lutwidge Dodgson was the real name of the author whom the world remembers as Lewis Carroll, author of *Alice's Adventures in Wonderland.* He was a lecturer on mathematics at Oxford University, a very shy, retiring person, who was usually afflicted by an awkward, nervous stammer when talking to grown-ups. But with children he was always completely at ease, and loved nothing better than to play with them or tell them stories, making them up as he went along.

LEWIS CARROLL

Charles Lutwidge Dodgson, published his stories for children, which included *Alice's Adventures in Wonderland,* over the name of Lewis Carroll. This sketch of the shy mathematician was made by one of his illustrators, Harry Furniss.

He had no children of his own, being a bachelor. But among his closest friends was H. G. Liddell, dean of Christ Church, Oxford, and joint-author of the famous Greek Lexicon popularly called "Liddell and Scott." Liddell had three little daughters, one of whom was called Alice. One summer afternoon Dodgson took the girls out on the river near Oxford. It was so hot that they landed in the meadows and sought the shade of a hayrick. And there, to pass the time pleasantly, he began to tell them about the delightful imaginary adventures of Alice. Later he wrote the adventures out in full and sent the story to the real Alice as a Christmas present, calling it *Alice's Adventures Underground.* But when the story was printed and published in 1865, the title was changed to *Alice's Adventures in Wonderland*, and the shy, sedate mathematician hid his identity from the public under the pen-name of Lewis Carroll.

He himself would have preferred it to be called simply *Alice in Wonderland* ; and indeed, most people do call it that anyway, although it is not strictly accurate.

The book became famous at once, and has been a firm favourite with children, and with grown-ups, ever since ; while the companion book, *Through the Looking-Glass and What Alice Found There*, 1871, has been almost equally popular. The two stories have been turned into a play, often revived at Christmas time, and more than once into a film (by Walt Disney, for example, in 1951). The many grotesque and comic characters that appear in the stories—such as the White Rabbit, the Cheshire Cat, the Duchess, the Hatter, the Red Queen, the White Knight, and Humpty-Dumpty—have been parodied over and over again in political cartoons, and you will often find them referred to in the most solemn leading articles in the newspapers.

Other books by Lewis Carroll include a long nonsense poem called *The Hunting of the Snark* (1876) and two connected stories called *Sylvie and Bruno* and *Sylvie and Bruno Concluded* (1889 and 1893); while under his real name he published several weighty works on mathematics.

We reprint below one of the best-loved passages from *Alice's Adventures in Wonderland.* It is impossible in a short space to do anything like justice to the whole story of the marvellous things that happened to Alice : how she fell down a rabbit-hole ; how her size was continually changing ; how she was nearly drowned in a pool of her own tears, and much else. You must read of these things for yourself, if you have not already done so. Meanwhile here is the account of the Mad Tea-party.

There was a table set out under a tree in front of the house, and the March Hare and the Hatter were having tea at it : a Dormouse was sitting between them, fast asleep, and the other two were using it as a cushion, resting their elbows on it, and talking over its head. "Very uncomfortable for the Dormouse," thought Alice ; "only, as it's asleep, I suppose it doesn't mind."

The table was a large one, but the three were all crowded together at one corner of it. "No room ! No room !" they cried out when they saw Alice coming.

"There's *plenty* of room !" said Alice indignantly, and she sat down in a large armchair at one end of the table.

"Have some wine," the March Hare said in an encouraging tone.

Alice looked all round the table, but there was nothing on it but tea. "I don't see any wine," she remarked.

"There isn't any," said the March Hare.

"Then it wasn't very civil of you to offer it," said Alice angrily.

"It wasn't very civil of you to sit down without being invited," said the March Hare.

"I didn't know it was *your* table," said Alice ; "it's laid for a great many more than three."

* * * * *

"Your hair wants cutting," said the Hatter. He had been looking at Alice for some time with great curiosity, and this was his first speech.

"You should learn not to make personal remarks," Alice said with some severity ; "it's very rude."

The Hatter opened his eyes very wide on hearing this ; but all he *said* was "Why is a raven like a writing-desk ?"

"Come, we shall have some fun now!" thought Alice. "I'm glad they've begun asking riddles—I believe I can guess that," she added aloud.

"Do you mean that you think you can find out the answer to it?" said the March Hare.

"Exactly so," said Alice.

"Then you should say what you mean," the March Hare went on.

"I do," Alice hastily replied; "at least—at least I mean what I say—that's the same thing, you know."

"Not the same thing a bit!" said the Hatter. "Why, you might just as well say that 'I see what I eat' is the same thing as 'I eat what I see'!"

"You might just as well say," added the March Hare, "that 'I like what I get' is the same thing as 'I get what I like'!"

"You might just as well say," added the Dormouse, which seemed to be talking in his sleep, "that 'I breathe when I sleep' is the same thing as 'I sleep when I breathe'!"

"It *is* the same thing with you," said the Hatter; and here the conversation dropped, and the party sat silent for a minute, while Alice thought over all she could remember about ravens and writing-desks, which wasn't much.

The Hatter was the first to break the silence. "What day of the month is it?" he said, turning to Alice: he had taken his watch out of his pocket, and was looking at it uneasily, shaking it every now and then, and holding it to his ear.

Alice considered a little, and then said "The fourth."

"Two days wrong!" sighed the Hatter. "I told you butter wouldn't suit the works!" he added, looking angrily at the March Hare.

"It was the *best* butter," the March Hare meekly replied.

"Yes, but some crumbs must have got in as well," the Hatter grumbled: "you shouldn't have put it in with the bread-knife."

The March Hare took the watch and looked at it gloomily: then he dipped it into his cup of tea, and looked at it again: but he could think of nothing better to say than his first remark, "It was the *best* butter, you know."

Alice had been looking over his shoulder with some curiosity. "What a funny watch!" she remarked. "It tells the day of the month, and doesn't tell what o'clock it is!"

"Why should it?" muttered the Hatter. "Does *your* watch tell you what year it is?"

"Of course not," Alice replied very readily: "but that's because it stays the same year for such a long time together."

"Which is just the case with *mine*," said the Hatter.

Alice felt dreadfully puzzled. The Hatter's remark seemed to have no meaning in it, and yet it was certainly English. "I don't quite understand," she said as politely as she could.

"The Dormouse is asleep again," said the Hatter, and he poured a little hot tea upon its nose.

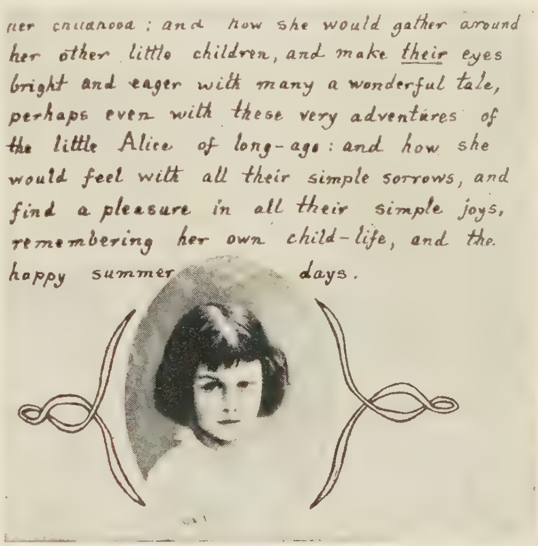
The Dormouse shook its head impatiently, and said, without opening its eyes, "Of course, of course; just what I was going to remark myself."

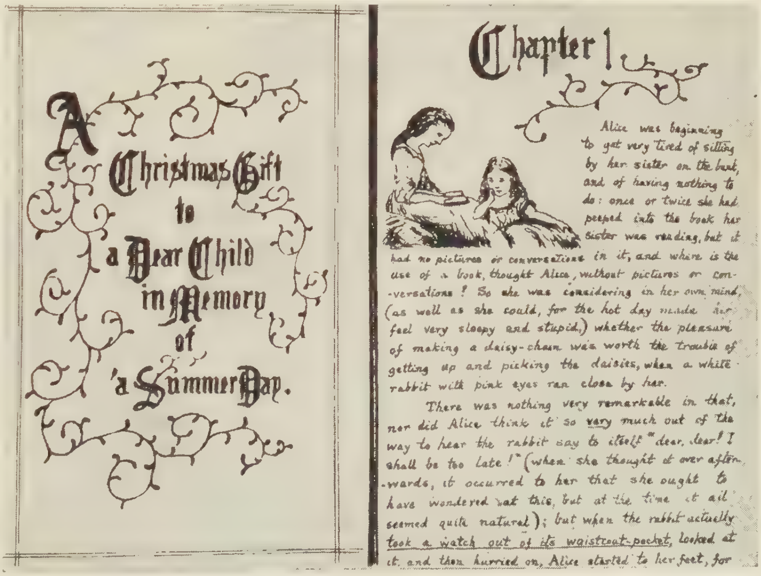
"Have you guessed the riddle yet?" the Hatter said, turning to Alice again.

"No, I give it up," Alice replied: "What's the answer?"

"I haven't the slightest idea," said the Hatter.

"Nor I," said the Hare.


her childhood: and how she would gather around her other little children, and make their eyes bright and eager with many a wonderful tale, perhaps even with these very adventures of the little Alice of long-ago: and how she would feel with all their simple sorrows, and find a pleasure in all their simple joys, remembering her own child-life, and the happy summer days.


A Christmas Gift to a Dear Child in Memory of a Summer Day.

Chapter I

Alice was beginning to get very tired of sitting by her sister on the bank, and of having nothing to do: once or twice she had peeped into the book her sister was reading, but it had no pictures or conversations in it, and where is the use of a book, thought Alice, without pictures or conversations? So she was considering in her own mind, (as well as she could, for the hot day made her feel very sleepy and stupid,) whether the pleasure of making a daisy-chain was worth the trouble of getting up and picking the daisies, when a white rabbit with pink eyes ran close by her.

There was nothing very remarkable in that, nor did Alice think it so very much out of the way to hear the rabbit say to itself "dear, dear! I shall be too late!" (when she thought it over afterwards, it occurred to her that she ought to have wondered at this, but at the time it all seemed quite natural); but when the rabbit actually took a watch out of its waistcoat-pocket, looked at it, and then hurried on, Alice started to her feet, for

THE MANUSCRIPT OF "ALICE IN WONDERLAND"

Lewis Carroll wrote out the story that he had told Alice Liddell and gave it to his friend as a Christmas gift. Alice grew up, married and became Mrs. Hargreaves, and went to the United States, where in 1928 the manuscript was sold for £15,400. Its return to Britain as a gift from the American people was announced in 1948. The upper photograph shows the last page of the manuscript, with a portrait of Alice; below are the first two pages, in miniature.

Alice sighed wearily. "I think you might do something better with the time," she said, "than waste it asking riddles with no answers."

"If you knew Time as well as I do," said the Hatter, "you wouldn't talk about wasting *it*. It's *him*."

"I don't know what you mean," said Alice.

"Of course you don't!" the Hatter said tossing his head contemptuously. "I dare say you never even spoke to Time!"

"Perhaps not," Alice cautiously replied: "but I know I have to beat time when I learn music."

"Ah! That accounts for it," said the Hatter. "He won't stand beating. Now, if you only kept on good terms with him, he'd do almost anything you liked with the clock. For instance, suppose it were nine o'clock in the morning, just time to begin lessons; you'd only have to whisper a hint to Time, and round goes the clock in a twinkling! Half-past one, time for dinner!"

THE MAD HATTER'S TEA PARTY

("I only wish it was," the March Hare said to itself in a whisper.)

"That would be grand, certainly," said Alice thoughtfully: "but then—I shouldn't be hungry for it, you know."

"Not at first, perhaps," said the Hatter: "but you could keep it to half-past one as long as you liked."

"Is that the way *you* manage?" Alice asked.

The Hatter shook his head mournfully. "Not I!" he replied. "We quarrelled last March—just before *he* went mad, you know—" (pointing with his teaspoon at the March Hare) "—it was at the great concert given by the Queen of Hearts, and I had to sing:

'Twinkle, twinkle, little bat!
How I wonder what you're at!'

You know the song, perhaps?"

"I've heard something like it," said Alice.

"It goes on, you know," the Hatter continued, "in this way:

'Up above the world you fly,
Like a tea-tray in the sky.
Twinkle, twinkle——'

Here the Dormouse shook itself, and began singing in its sleep, "Twinkle, twinkle, twinkle, twinkle——" and went on so long that they had to pinch it to make it stop.

"Well, I'd hardly finished the first verse," said the Hatter, "when the Queen jumped up and bawled out 'He's murdering the time! Off with his head!'"

"How dreadfully savage!" exclaimed Alice.

"And ever since that," the Hatter went on in a mournful tone, "he won't do a thing I ask! It's always six o'clock now."

A bright idea came into Alice's head. "Is that the reason so many tea-things are put out here?" she asked. "Yes, that's it," said the Hatter with a sigh: "it's always tea-time, and we've no time to wash the things between whiles."

"Then you keep moving round, I suppose?" said Alice.

"Exactly so," said the Hatter: "as the things get used up."

"But what happens when you come to the beginning again?" Alice ventured to ask.

"Suppose we change the subject," the March Hare interrupted, yawning. "I'm getting tired of this. I vote the young lady tells us a story."

"I'm afraid I don't know one," said Alice, rather alarmed at the proposal.

"Then the Dormouse shall!" they both cried. "Wake up, Dormouse!" And they pinched it on both sides at once.

The Dormouse slowly opened his eyes. "I wasn't asleep," he said, in a hoarse, feeble voice: "I heard every word you fellows were saying."

"Tell us a story!" said the March Hare.

"Yes, please do!" pleaded Alice.

"And be quick about it," added the Hatter, "or you'll be asleep again before it's done."

"Once upon a time there were three little sisters," the Dormouse began in a great hurry; "and their names were Elsie, Lacie, and Tillie; and they lived at the bottom of a well——"

"What did they live on?" said Alice, who always took a great interest in questions of eating and drinking.

"They lived on treacle," said the Dormouse, after thinking a minute or two.

"They couldn't have done that, you know," Alice gently remarked; "they'd have been ill."

"So they were," said the Dormouse; "*very* ill."

Alice tried a little to fancy to herself what such an extraordinary way of living would be like, but it puzzled her too much, so she went on: "But why did they live at the bottom of a well?"

"Take some more tea," the March Hare said to Alice, very earnestly.

"I've had nothing yet," Alice replied in an offended tone, "so I can't take more."

THE MAD HATTER SINGS

"You mean you can't take *less*," said the Hatter; "it's very easy to take *more* than nothing."

"Nobody asked *your* opinion," said Alice.

"Who's making personal remarks now?" the Hatter asked triumphantly.

Alice did not quite know what to say to this: so she helped herself to some tea and bread-and-butter, and then turned to the Dormouse, and repeated her question. "Why did they live at the bottom of a well?"

The Dormouse again took a minute or two to think about it, and then said, "It was a treacle-well."

"There's no such thing!" Alice was beginning very angrily, but the Hatter and the March Hare went "Sh! sh!" and the Dormouse sulkily remarked, "If you can't be civil, you'd better finish the story for yourself."

"No, please go on!" Alice said very humbly. "I won't interrupt you again. I dare say there may be *one*."

"One, indeed!" said the Dormouse indignantly. However, he consented to go on. "And so these three little sisters—they were learning to draw, you know——"

"What did they draw?" said Alice, quite forgetting her promise.

"Treacle," said the Dormouse, without considering at all this time.

"I want a clean cup," interrupted the Hatter; "let's all move one place on."

He moved on as he spoke, and the Dormouse followed him: the March Hare moved into the Dormouse's place, and Alice rather unwillingly took the place of the March Hare. The Hatter was the only one who got any advantage from the change; and Alice was a good deal worse off than before, as the March Hare had just upset the milk-jug into his plate.

Alice did not wish to offend the Dormouse again, so she began very cautiously: "But I don't understand. Where did they draw the treacle from?"

"You can draw water out of a water-well," said the Hatter; "so I should think you could draw treacle out of a treacle-well—eh, stupid?"

"But they were *in* the well," Alice said to the Dormouse, not choosing to notice this last remark.

"Of course they were," said the Dormouse; "——well in."

This answer so confused poor Alice, that she let the Dormouse go on for some time without interrupting it.

"They were learning to draw," the Dormouse went on, yawning and rubbing its eyes, for it was getting very sleepy; "and they drew all manner of things—everything that begins with an M——"

"Why with an M?" said Alice.

"Why not?" said the March Hare.

Alice was silent.

The Dormouse had closed its eyes by this time, and was going off into a doze; but, on being pinched by the Hatter, it woke up again with a little shriek, and went on: "——that begins with an M, such as mouse-traps, and the moon, and memory, and muchness—you know you say things are 'much of a muchness'—did you ever see such a thing as a drawing of a muchness?"

PUTTING THE DORMOUSE INTO THE TEAPOT

Illustrations by Sir John Tenniel, reproduced by permission of Messrs. Macmillan & Co., Ltd.

"Really, now you ask me," said Alice, very confused. "I don't think——"

"Then you shouldn't talk," said the Hatter.

This piece of rudeness was more than Alice could bear: she got up in great disgust, and walked off; the Dormouse fell asleep instantly, and neither of the others took the least notice of her going, though she looked back once or twice, half hoping that they would call after her: the last time she saw them, they were trying to put the Dormouse into the teapot.

"At any rate I'll never go *there* again!" said Alice as she picked her way through the wood. "It's the stupidest tea-party I ever was at in all my life!"

Carrot. Whether you like the taste of carrot, cooked or raw, or whether you loathe this root vegetable in any form, you have to admire the skill and patience of the plant-breeders who helped to change the carrot from a poor little wildling to a succulent food. In its edible form the carrot (*Daucus carota*) was introduced from the Continent into England in the time of Queen Elizabeth I.

In its wild form it is quite common in hedgerows and waste places in Britain, throwing up its fern-like growth sometimes to three feet in height and making a really attractive display with its flat heads of densely packed small white flowers (family *Umbelliferae*). In general these flowers are not produced under cultivation; the plant is a biennial, which means that it cannot flower until its second year of growth. The cultivated plants do not get a second year (unless seed production is required) for the roots are dug up while they are still young.

The tap-root of the wild carrot is dry and thin and woody, and from this has been derived all the present sweet and fleshy varieties, some cylindrical and stumpy, some long and tapering, and red or yellow in colour. As a food these fat tap-roots are rich in carbohydrates and are very nutritious.

Carthage. About 850 B.C. the Phoenicians from the city of Tyre (situated in a country later known as Syria) founded on the edge of the region now called Tunisia, in northern Africa, the city of Carthage, which became the commercial

RUINED CARTHAGE TAKEN BY A BRITISH ARMY

In 1943 Winston Churchill addressed the victorious troops in the ruined amphitheatre at Carthage, Tunisia, when modern history was being made in this ancient setting. After the Romans had captured and destroyed Carthage at the end of the Third Punic War (149–146 B.C.), they founded a colony on the same site in 122 B.C.

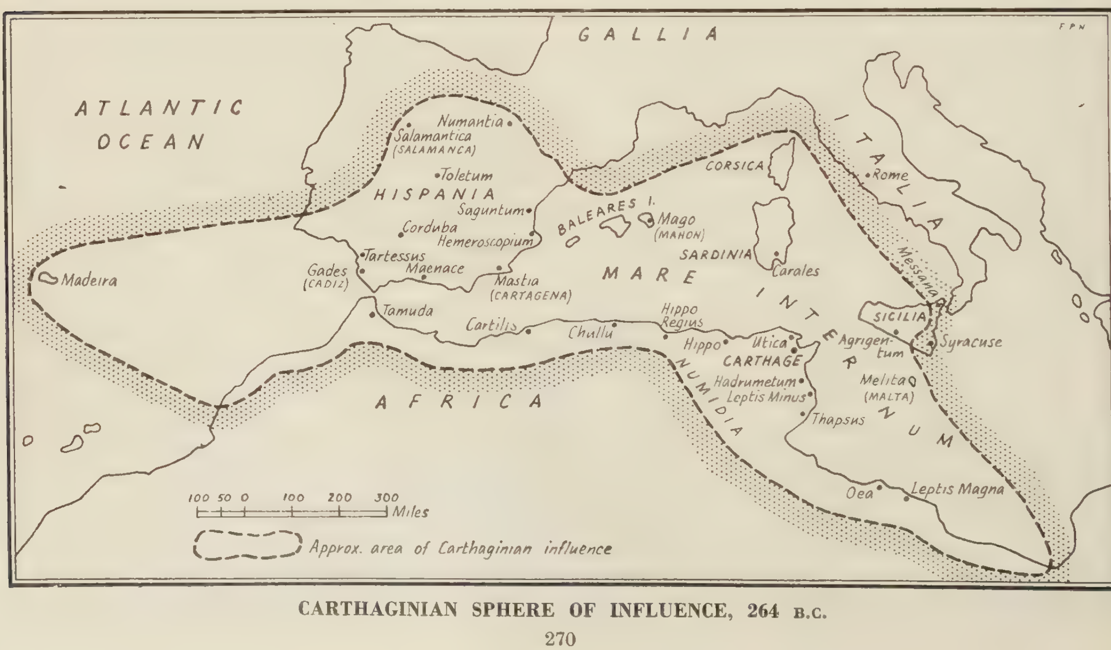
queen of the western Mediterranean until overthrown by its powerful rival, Rome.

According to tradition, Carthage was founded by Queen Dido, who had fled from Tyre. The oldest part of the town was called Byrsa (citadel). Legend connected this name with the Greek *byrsa* (hide) in allusion to the story that the people of the neighbourhood agreed to give Dido as much land as could be enclosed by an ox-hide. Dido cut the hide into small strips and thus surrounded a large area, on which she founded the city. There, according to the *Aeneid* of Virgil (Roman poet, 70–19 B.C.), the Trojan warrior Aeneas visited her on his wanderings after the fall of Troy.

The advantageous situation of Carthage gave it unrivalled commercial opportunities, and it became a large and splendid city, with docks and piers teeming with ships and merchandise. Behind these the city spread far inland, with markets and busy manufacturing quarters. The trade of Carthage was carried afar. Its colonies sprang up in northern Africa, in Spain, and in the islands of the Mediterranean; and its ships were in control of the inland sea.

After Rome had gained the mastery of Italy, that city soon came into conflict with Carthage, for without the permission of Carthage, as one of its officers boasted, "no Roman might even wash his hands in the Mediterranean." As a result there began the Punic Wars, lasting over 100 years. The first war (264–241 B.C.) was fought in Sicily, and ended in the withdrawal of the Carthaginians from that island and the payment of an indemnity to Rome.

The Second Punic War (218–201 B.C.) is sometimes called the War with Hannibal, after that



CARTHAGINIAN SPHERE OF INFLUENCE, 264 B.C.

great Carthaginian general (*see* HANNIBAL). He invaded Italy from Spain, crossing the Alps with a train of elephants. Although he defeated the Romans at Cannae, the peoples subject to Rome failed to rally to his support. In the end he was recalled to Africa, where the Roman Scipio Africanus was attacking Carthage itself. This war ended with yet more severe terms for Carthage, including its withdrawal from Spain and the surrender of its navy.

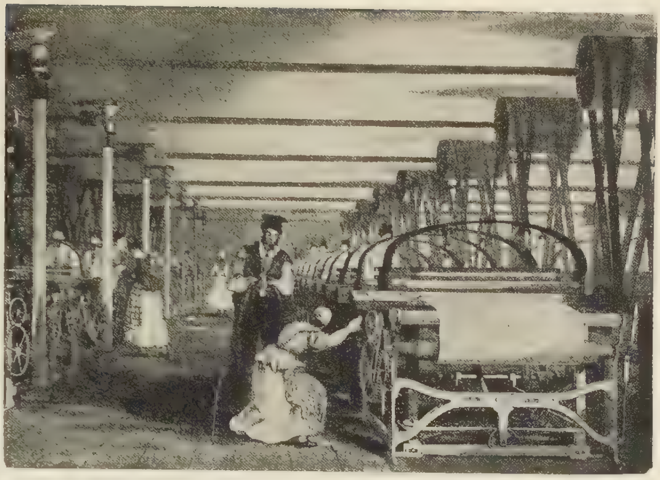
The third war (149–146 B.C.) was caused by the jealousy of Rome at signs of reviving commercial and maritime strength in Carthage. After a heroic resistance, in which Carthaginian women cut off their hair to make cordage for the catapults, or hurling machines, their city was taken. For some years the Roman senator Cato, who had been greatly impressed with the city when he visited it, had ended almost all of his speeches—no matter what the subject—with the words, "Carthage must be destroyed" (*Delenda est Carthago*). This ruthless policy was now adopted, and Carthage was razed to the ground.

A Roman colony was established on the same site in 122 B.C., and became the Roman seat of a government in Africa. When the Vandals (a German tribe which had overrun Spain) took the city in 439, Carthage became a pirate stronghold. After the Arabs captured it in 698 it was again destroyed. To-day only a few ruins mark the site. But excavations by archaeologists and classical scholars continue.

Cartwright, EDMUND (1743–1823). This clergyman of the Church of England was 41 years old when a chance conversation caused him to turn inventor. While on a holiday, he met a party of Manchester men, and there was animated talk of Arkwright, the inventor, and of the flourishing spinning mills that were producing yarn faster than the old hand-looms could spin it into cloth. "Your clever Mr. Arkwright should give his attention to the invention of a power-loom," Mr. Cartwright observed thoughtfully. He was told it could not be done, but the idea got hold of him. He knew nothing of machinery, but on his return home he promptly set to work on the problem.

If you examine a piece of woven cloth, you will see that it is made up of two sets of threads which cross at right angles (*see* LOOM). The threads running lengthwise are called the warp, and those running crosswise and interlacing are called the weft. In the old hand-loom the shuttle which carried the weft was thrown by hand backwards and forwards through the space made by opening up the threads of the warp. After a year of experimenting, Cartwright in 1785 produced a machine, worked by water-power, which would throw the shuttle backwards and forwards and perform the other operations necessary in weaving.

The introduction of the power-loom was violently opposed by the hand-loom weavers, and Cartwright's first mill of 400 looms was burned by rioting workmen. This calamity, together with expensive lawsuits to protect his patents, exhausted his private fortune. Parliament, however, in 1809 voted him £10,000 as a reward for his inventions, which included a wool-combing machine, a type of machine which is still used for making rope, and also various agricultural implements.



IN THE EARLY DAYS OF THE POWER-LOOM

The Rev. Edmund Cartwright (1743–1823) evolved his first power-loom in 1785, patenting improvements in the two following years. Other improvements were effected, and by 1830—the date of the machines shown in this picture—power-looms were in general use.

From Baines, "History of the County Palatine of Lancashire"

Caspian Sea. The largest inland body of water in the world is the Caspian sea, lying on the boundary between Europe and Asia. About 760 miles long, it varies in breadth from 120 to 300 miles. It is entirely in Soviet Russia except for the southern portion, which projects into Persia.

Long ago the Caspian, the Mare Caspium or Mare Hyrcanium of the Romans, was part of a much larger sea, which may have joined the Sea of Azov (an arm of the Black Sea) on the west, included the Sea of Aral in Central Asia on the east, and on the north extended to the Arctic. To-day, however, the surface of the Caspian is 85 feet below that of the Mediterranean Sea. In the southern part it is very deep, reaching down to 3,000 feet, but in the north it is shallow.

The Caspian has no outlet and is consequently a salt lake, though it is less salt than the ocean. The water is bitter, and yellowish in colour. The sea is fed by a number of rivers, among which are the Volga (one of the most important rivers in Russia), the Ural, the Terek, and the Kur. The water evaporates faster than it can be replaced by the rivers, so the sea is gradually getting smaller, and old beaches are found high above the present water-line. By canals connected with the Volga it is possible to reach the Black Sea on the west and the Baltic and White Seas far to the north.

The oil wells near Baku and the fisheries at the river mouths make the Caspian of great commercial importance. Few other waters are so richly stocked with fish; and large quantities of caviare are made from the eggs of the sturgeon. Among the chief Caspian ports are Astrakhan, Baku, Makhach-Kala, Derbent, and Krasnovodsk, in Russia; and Enzeli (for Resht) and Bandar Shah, terminus of the trans-Persian railway, in Persia.

FORTRESS HOMES *of the* BARONS

Ministry of Works: Drawing by Alan Sorrell

HARLECH CASTLE IN THE DAYS OF CHIVALRY

The Welsh stronghold is shown in the drawing as it is believed to have appeared in about the year 1300, seventeen years after Edward I had begun to build it. The stubborn defence of Harlech Castle against the Yorkists in 1468 is believed to have inspired the stirring Welsh song "The March of the Men of Harlech." Built on a rock platform 200 feet above the marshes, it is a splendid example of the Edwardian system of concentric fortification.

Castle. This combination of fortress and dwelling was originally built in Britain not to protect the country against foreign enemies but to defend a ruling class of Normans against the only partly-subdued Saxon population. To-day, for people of imagination, even the ruin of a castle generally holds some interest, especially where enough fragments of the building are left to give some idea of its plan and elevation; but many famous British castles are still in use, although they may now look very unlike their first shape centuries ago.

Windsor Castle has been a royal residence for 850 years; Warwick and Berkeley are still homes of noblemen; Edinburgh, Dover, and the Tower of London are still fortresses; Durham houses a university, Alnwick a training college, Herstmonceux the Royal Greenwich Observatory. The name "castle" was also given to certain nineteenth-century houses built to look something like medieval strongholds. Examples range from Balmoral, the Queen's home in the Scottish Highlands, to the diminutive Castell Coch perched on a wooded hillside near Cardiff.

The first Norman castles were almost all of wood, although the idea of stone defences was certainly in the heads of Norman nobles and architects. Only King William himself had the resources to begin with stone at the White Tower of the Tower of London and a few other sites, although one of his captains, Alan of Brittany, was almost as far ahead with Richmond Castle in Yorkshire, and actually farther ahead in his plan of an outer wall and towers so strong that no inner range of defence was necessary.

The Bayeux Tapestry shows the usual eleventh-century Norman practice of throwing up a great *motte* or mound of earth with a ditch round it. (This name *motte* later rolled down the slope, so to speak, and landed in the ditch, which became known as the "moat.") Such a mound was a flat-topped cone, with a stockade round its rim,

[Continued on page 275

TOWERS & BATTLEMENTS OF BRITISH CASTLES

J. Dixon-Scott

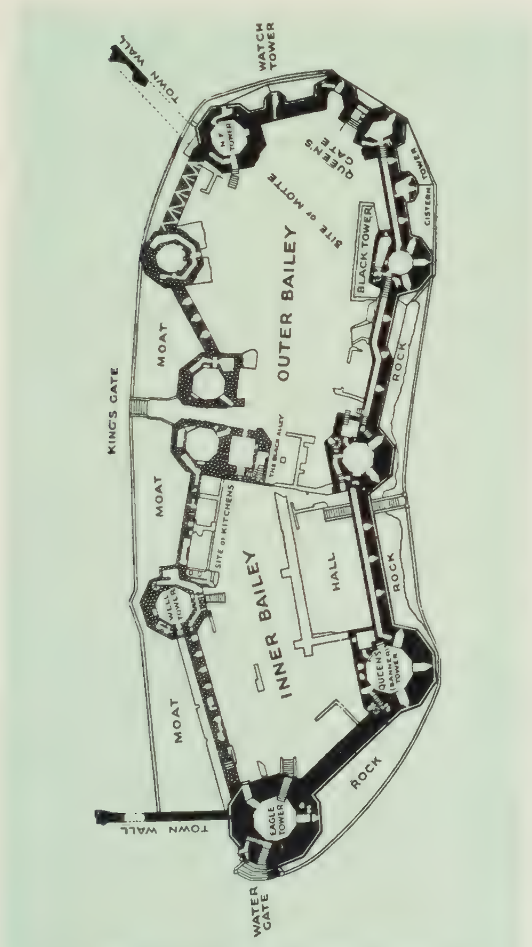
One of the most famous of English castles is that of Dover, seen here. Much of this majestic fortress was built by Henry II (1133–89), and in 1213 King John sought refuge behind its walls from the anger of the barons. Dover Castle has a massive keep, which, with the White Tower in the Tower of London, forms the finest pair of examples of Norman keep in England. Within the castle precincts are the remains of a Roman pharos or beacon tower, and a medieval church. In the chalk rock beneath the castle is an extraordinary system of secret passages, which enabled the defenders to sally forth unexpectedly and counter-attack a besieging force.

CAERNARVON CASTLE, LITTLE CHANGED SINCE PLANTAGENET TIMES

The building of Caernarvon Castle, in North Wales, was begun by Edward I in 1283, when he began the organization of the newly-conquered principality. The stronghold helped to command the Menai Straits. Edward's son, later Edward II, was born at Caernarvon in 1284, and tradition has it that the king displayed the infant to the Welsh people as their native-born prince "who cannot speak a word of English." The young Edward was in fact created Prince of Wales in 1301. Only one of his successors, the future Edward VIII, now Duke of Windsor, was actually invested with the principality here in Wales in 1911.

and some kind of timber tower, or "keep," rising in the middle. Partly encircling the ditch was a levelled area called the "bailey," itself surrounded by a stockaded earthen rampart having another ditch dug on its outer side. In the bailey in wooden sheds were kept the horses and, no doubt, cattle and other livestock that could not be taken up the mound. Entry to the motte stockade was by a wooden bridge and stair. Entry to the bailey from outside the castle was by a level bridge, not at first of drawbridge type.

Out of this simple motte-and-bailey plan, often



PLAN OF CAERNARVON CASTLE

something like the outline of a cottage loaf, was developed by stages much of the layout of castles of later days. When the motte-and-bailey adjoined a town, they were usually set astride the town wall or outside it, sure evidence that the townspeople might be as hostile as any force from elsewhere; but it must be emphasised that the Normans took every advantage of rocky sites and river loops and other natural features, and neither motte nor ditch was always required.

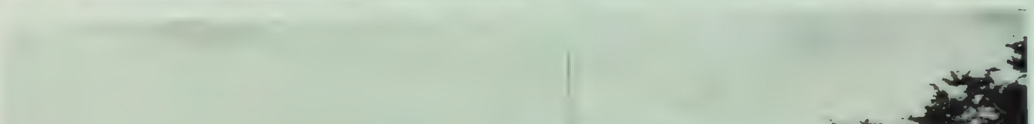
Once established in the timber castles the king had licensed them to build, the barons soon began to substitute stone defences. Attack by fire was the chief danger before siege engines were much used; therefore the outer or curtain wall, or at least its main gatehouse, might be the first stone erection. Here again there was no rule. Some castles had lengths of stockaded rampart as late as 1300, when the keep and perhaps other towers were already of stone; a stone curtain always had projecting towers so that archers could shoot sideways along the face of it.

During the reign of Henry II (1154–89) many motte stockades were replaced by high stone walls or "shell keeps" surrounding the owner's hall or dwelling, but the solid square keep had already appeared, occupying the whole top of the mound. In this the hall was on the first floor, an outside staircase giving entry at that level, and the ground floor contained store-rooms entered by trapdoors from above. The family apartments were on the second floor (though most of the household slept on rushes in the hall). The flat battlemented roof was sometimes used as the kitchen; the cooking fires and cauldrons could also be used to boil oil and melt lead for pouring down on attackers.

If a motte could not take the weight of a stone keep, a new keep would be built somewhere else in the bailey, without a mound but perhaps attached to the curtain wall. Towards 1300, cylindrical keeps appeared in England; their slits gave wider shooting-angles, and their surfaces were harder to break with stones flung by siege engines. The keep, however, had no active power except to repulse direct attack, and it could often be "contained" by a small beseiging force until famine, treachery, or despair led to surrender. It became a purely military feature; castles developed inner and outer baileys, and the hall, the chapel, and the private living quarters were built outside the keep and inside—often against—the curtain. By about 1350, keeps were going out of favour; Edward I was planning great castles in Wales to contain not a household but a complete striking force. He adapted the lines of curtain-walls to the sites, and also made use of the "concentric" plan (perhaps observed on his crusade) whereby an outer wall was commanded by a higher wall inside it. The Tower of London was among English castles transformed into a concentric fortress of this type.

Edward made the monarchy so strong that the baronage lost power and inclination to updrawbridge and defy the king. A last splendid baronial building was that of Bodiam in the early fifteenth century, licensed with an eye to the frequent French raids on the Sussex coast. During the wars of Lancaster and York the cannon of Edward IV battered to surrender the castles of the great Percy family in Northumberland; military power had shifted to the royal siege-train. In the sixteenth century the mansion built by the Protector Somerset within the walls of his castle of Berry Pomeroy displayed the impatience of rich men with homes planned for defence rather than for comfort. When in the Civil War castles again became fortresses protecting the Royalist cause, their walls sometimes stood up well to the Parliamentary cannonade, but for one reason or another their garrisons had to yield, and Oliver Cromwell took no chances; he had many of the buildings "slighted" or made indefensible. Since then only German guns have been fired at British castles.

FORTIFIED HOMES OF MEDIEVAL DAYS



Upper, J. Dixon-Scott

These two photographs are of medieval strongholds, the upper one showing Newark Castle, which occupies a strategic position beside the river Trent in Nottinghamshire, and was formerly called the Key of the North. King John died in the castle in 1216 (see the story beginning on opposite page). During the Civil War (1642–48) it withstood three sieges by Cromwell's troops. Stokesay Castle (lower picture) in Shropshire is really a fortified manor-house dating from the 13th century and surrounded by a moat.

OSWALD AT NEWARK CASTLE, A.D. 1216

OSWALD was a turnspit in the kitchen of the king's castle at Newark. He stood for most of the day beside the great joints of meat, turning them slowly so that they roasted evenly, and sometimes scooping out the dripping which gathered in a big wooden trough underneath.

He was a quiet boy, fourteen years old, obedient and useful to Adam the Cook. Adam was a stern master in the kitchen, and if he grew angry he hit Oswald and the others with a great wooden spoon, but he would not let anyone else interfere with them.

Because of this they were all grateful, for in castles the soldiers were often idle, and usually stupid and cruel as well. Sometimes they amused themselves by throwing things at the servants or tripping them up as they carried burdens from the stores to the kitchen.

Oswald kept warm at night, for he had a blanket of his own, and slept on a sack stuffed with straw beneath one of the great kitchen benches. When the wind got up and rain rattled on the roof-tiles, he would lie awake for a moment or two, watching the firelight as it flickered on the floor, and thinking of his family in their leaky hut at the edge of the town. They were very poor people; Oswald's father ploughed and ditched on the castle lands, and his brother and sister herded pigs and scared away crows from the crops.

What Oswald liked most about life in the castle was that he got enough to eat, and sometimes he managed to take out to his mother a piece of pork or a slab of cheese hidden under his ragged cloak.

If there were many people eating in the castle hall, Oswald helped with the serving and the clearing away. That was how he came to find a silver penny on the morning of Saint Luke's Day, after the great storm.

At that time the constable of the castle was Messire Roger de Gaugy, one of the foreign soldiers who served the king. King John was a monster of greed and cruelty, and the men who supported him were mostly nearly as bad. Roger de Gaugy was a great fat robber captain, who loved eating as well as fighting, so that the English called him Gorgy. *Gorge* was the French for *throat*, and Englishmen who served in castles had to learn their masters' words for ordinary things.

A hundred and fifty years had passed since the Normans began to conquer England, but they and the other foreigners with them still despised the English. Most of their castles were of stone now, or at least had stone keeps and gateways, but at Newark one side of the castle enclosure had only an earthen rampart, with a stockade along the top above the deep wide moat or ditch.

Because Gorgy liked stuffing himself, Adam Cook was one of his most important officers. Oswald was not very clever, but he had noticed that much, and he studied Adam Cook and his ways until he knew by the lift of Adam's eyebrow just what was wanted next.

In those days the country was filled with savage warfare. The barons were fighting King John and each other, the French Dauphin and the King of Scots both had armies in England, and everywhere there was treachery and misery and fear. King John's own army came trampling up the Midlands, chasing King Alexander northwards, and then turning aside to plunder the rich farming country around the Isle of Ely. In Newark Castle the tale was told how at Crowland King John sent one of his captains to burn the barns and standing corn belonging to the great abbey, while he waited and watched a little way off. The monks met the captain and gave him a ransom of silver to leave them in peace. But when the captain took the money to the king, John cursed him for disobedience and rode forward himself.

Dismounting, he snatched up a flaming torch, and told his soldiers to do as he did. So the monks lost their silver and their harvest too, while the king ran about among the blazing barns, yelling like a demon, his face red with rage and blackened by smoke and soot. It made Oswald shiver a little to hear that story.

Then, on a cloudy October afternoon, when the

wind blew harsh and chill from the east, two mail-clad riders galloped up to the castle of Newark. Oswald heard their horses' hoofs go *clickety-click* on the cobbles beyond the outer gate, *thumblety-thud-thump* on the planks of the drawbridge, and *clackety-clop-clack-clump* on the stone pavement of the bailey.

"Word from our lord the king," said one, as they jumped from their saddles. Gorgy came waddling down from his own rooms in the great tower, which there was both gateway-tower and keep. And in a few minutes the castle was humming like a beehive poked with a stick.

King John was coming in a litter, very ill and very angry, with all his plans ruined by a sudden great stroke of misfortune. His baggage-train had been overwhelmed in quicksands under a rising tide, so that most of his treasure was lost. Scores of men and hundreds of horses and cattle and sheep had been drowned. Dozens of waggons had gone down, laden with money and food and wine and weapons and tents and stores of every kind.

And in a fearful rage King John had ridden on to an abbey, where he drank new cider and gobbled peaches and then was taken ill. But he went forward next day, and for several days afterwards, and now that his gold and silver were gone his soldiers began to desert him. Those who marched into Newark with him looked as though they had lost a battle.

So at least Oswald thought as he stared out of a kitchen window. The king was riding a quiet horse now, instead of one of his great chargers. His litter had given him such a jolting that he could not bear to stay in it. His eyes were wild in the broad bearded face under his glittering helmet. He nearly fell from his saddle into the arms of Roger de Gaugy.

The few pack-horses that had escaped were led in after him, followed by groups of tired and sullen soldiers. The king was put to bed in the keep, and in the kitchen Oswald and the others were nearly run off their legs. Some of the king's own servants came in to help them, and that was how Oswald heard of the quicksands and of the peaches and cider.

* * *

Gorgy set several of his own soldiers to guard the doors of the kitchen, so that none of the king's men could wander in and help themselves. Gorgy and the king's clerks had their supper in the keep, and then Adam Cook and his staff began feeding the hall-full of armed and hungry strangers.

Little Oswald stepped like a hen over long booted legs and sheathed swords and dangerous battle-axes. The bearded foreigners growled at him and snatched the food he offered them—bread, and cheese, and meat stuck on skewers, and the kind of sausage then called puddings, and hard-boiled eggs, and apples. Barrels of ale were rolled in, and the soldiers drank and began to cheer up. When they had eaten they went on drinking, and some began to play games with dice. Soon they were swearing at Oswald if he passed between them and the light of the torches that stood in iron stands or on brackets sticking out from the wall.

The rushes on the floor grew full of greasy bones and crusts and apple-cores and cheese-rind and the slippery skins of puddings. Generally Gorgy's hounds came in and ate what they wanted, but to-night Gorgy had had them locked in their kennels and fed there by his grooms. Oswald hovered about and picked up trays and baskets where he could, and Adam Cook told him not to try to sweep up the rubbish. And after a lot of scouring and cleaning in the kitchen Oswald crept under the bench and fell fast asleep without even taking off his shoes.

Next morning the kitchen people had to be roused even earlier than usual. Oswald hardly looked up when the Abbot of Croxton rode into the castle. This abbot was a physician too, and Gorgy had asked him to come and look after the king. That day King John had a number of letters written by his clerks, and carried away by soldiers riding in twos and threes. Next day again a number of knights from the country round about came to the castle, but by then the king was too ill to see or speak to them, and after waiting for a while they all went away.

The king's soldiers lazed in the hall, played rough games in the bailey, went out to the archery-butts, or fished from the river-bank. Some were lodged in the town, where they took what they wanted without paying for it. Gorgy could do nothing, for his own men were fewer than the others, and he needed them all to keep watch on the roads and to guard his stores and stables. Oswald had always been afraid of the soldiers in the castle, but now he found he thought of them almost as friends, although of course they too were mostly Normans or Picards or Gascons or Flemings from over the sea.

* * *

And so three days went by, with the castle larders emptying as though by magic. Adam Cook grew worried and angry and hit out often with the wooden spoon, while Oswald trudged and stumbled about, wanting only to go to sleep.

On the evening of the third day the wind, which had dropped, got up again. Coming this time from the south-west, it blew harder from hour to hour. Even within the castle enclosure men's cloaks blew round their ears. Straw and rubbish whirled to the top of the stockade, and pigeons zigzagged wildly about as though unable to steer their way to the pigeon-cotes on the stable roof.

When Oswald had time to think he sometimes wanted to laugh, for now the savage king was unable to stand on his legs or set fire to anyone's barns and haystacks.

But Oswald kept a solemn face as he went about his work, for the king's men were rested and ripe for mischief, and all the while the wind blew louder over the fenlands and forests. When twilight fell the flames of torches were flattened out along the walls, while smoke and sparks whirled everywhere amid thin gusts of rain. Sentinels on the rampart walks held on to the battlements or huddled into corners, and in the kennels Gorgy's hounds whined and yowled as though they were afraid.

At supper-time the hall grew noisy almost as soon as the meal began. Oswald ran to tell Adam Cook that soldiers were quarrelling and

Adam the Cook was a stern master in the kitchen, and if he grew angry he hit out at Oswald and the others with a great wooden spoon, but he would never let anyone else interfere with them ; and because fat Messire Roger, the constable, was very fond of eating and drinking, Adam Cook was one of the most important officers in the castle.

drawing their swords. Adam went up the covered stair to look round the great screen at the back of the hall dais.

" Don't go in there any more till I tell you," he said. " Leave the food here, on the dais, and let them get it themselves."

So Oswald and the others went back to the kitchen, and the noise of the soldiers and the noise of the gale mixed and parted and mixed again, growing wilder and wilder as the night went on. The three of Gorgy's soldiers on guard at the kitchen doors shut them and had supper with the servants. Oswald was frightened, but he soon went off to sleep, sitting against the wall with a horn of ale in his lap.

He was roused by a shouting and banging, and got up in time to see Adam Cook unbar a door, while the soldiers stood with their crossbows ready, and the older servants caught up spits and choppers and anything else that came handy. Gorgy's head groom came staggering in, with a club in one hand, and the other held up to his cut and bleeding face.

" The king's dead," said the groom, and everyone made the sign of the Cross. " His clerks and servants are plundering all the stuff he had left. The soldiers are mostly drunk and snoring, but some of them are trying to break into the armoury and stables. I can't rouse Messire Roger. He's drunk too. Adam, what'll we do ? "

King John came riding in on a quiet horse, instead of on one of his great chargers. He was ill, and all his plans had gone astray ; he nearly fell from his saddle into the arms of Roger de Gaugy.

He swayed, and Adam caught him and pushed him on to a bench. Oswald held out his horn of ale, and Adam gave it to the groom.

" But what about the Abbot ? " asked Adam.

" He's busy embalming the king's body, and his chaplain's standing on guard with a battle-axe. Some of his servants are with my lads, holding the forge and stables. The archers who were posted there all went off to the hall."

Adam told the three soldiers to go to help the grooms, but the soldiers said he was not their captain, and they had been told to guard the kitchen. They handled their crossbows and grinned, and nobody wanted to be shot through, so for a time the servants stood and sat about, listening and doing nothing.

Outside the gale howled, and the king's men plundered and fought in the rain and darkness. After a while Adam Cook persuaded the soldiers to let him go out. Presently he came back to say that the castle gates were open.

" It's crack of dawn," he went on. " The Abbot and his men have taken their horses and fled. The king's servants and soldiers are running away with everything they can carry. But I roused Messire Roger, and he said he's coming down."

The three soldiers looked at each other, and one beckoned the others outside, and none of the kitchen servants ever saw them again.

" Come on, lads," said Adam. " That lot in the hall will be waking soon. Better have food ready for them."

So Oswald set about his work among the caldrons and pans and gridirons, the pots and pestles and bowls, the flesh-hooks and forks with great curved prongs and handles two feet long. Sometimes he was turning the spit with one hand and doing something else with the other, half-asleep but keeping his wits fixed on Adam Cook's voice.

Morning light grew in the castle, showing doors burst off their hinges, and tiles smashed where they had blown from the roofs, and one or two wounded men lying senseless in the rain. These were presently dragged into shelter by some of the castle grooms. By now Gorgy was stamping about in full armour, giving orders to anyone he saw outside the hall. Gradually he collected a party of his own men, and then told Adam Cook to have food taken to the others.

So again Oswald went stepping and slithering over and between the sprawling soldiers, while Gorgy stalked up to the dais and made a speech in Norman-French. The soldiers growled and shouted replies to what he asked them, and presently they began to scramble up and buckle on their belts and shoes and heavy coats of mail or leather. Then they streamed out into the bailey, where now a black-draped litter stood ready for King John's last journey.

Oswald and half-a-dozen others were told to sweep up the mess in the hall. When they had gathered two great heaps of rubbish beside the doors, Adam Cook came in and told them to stop work for a while.

The gale had dropped to a breeze, and the breeze had died into a calm. Towards noon a mist rolled out of the forest and along the river. All that was left of King John's army—two or three hundred foreign men-at-arms—formed up in the bailey. They were going to honour the king's last wish and take his body to be buried at Worcester.

Neither banners nor trumpets went with them for all were lost or stolen. Gorgy's own banner, with a red cross on its blue-and-white ground, was the only one to be dipped in salute as the procession moved off. A monk whom Gorgy had met in the town was the only churchman to raise a hand in blessing.

Gorgy's soldiers stood in two ranks with the castle servants behind them. Presently the last of the mail-clad strangers had shuffled and splashed drearily away into the mist.

Oswald went back into the hall and took up his great broom. As he began sweeping again he saw something shining in the rubbish at his feet.

And when anyone asked Oswald to tell them what happened that night in the castle, he always finished his tale in exactly the same way.

"But the best of it was, next morning I found a silver penny."

Castor and Pollux. These twin heroes of ancient Greek myth, brothers of Helen of Troy, were variously regarded as sons of the god Zeus and Leda, wife of Tyndareus, king of Sparta, or of Tyndareus and Leda; or Castor was said to be the son of Tyndareus, and Pollux the son of Zeus. They were members of the Argonauts (see article) and rescued their sister, Helen of Troy, by invading the city-state of Athens.

Pollux was widely renowned as a skilled boxer, and Castor was famed as a tamer of horses. Sailors in storms prayed to them, and they became the patrons of travellers and of hospitality as well as of public games. According to one story, Zeus set them among the stars after their lives on earth, and the constellation of Gemini (the twins) is named after them. Also known as the Dioscuri (children of Zeus), they were worshipped especially by the Dorians in northern Greece, and also in Rome, where it was believed that the victory of the Romans over the Latins at Lake Regillus (496 B.C.), was due to the help of the "Great Twin Brethren." This battle forms the subject of one of the finest of Macaulay's *Lays of Ancient Rome*.

Cat. All the cats in the world are part of one great family, the *Felidae*, which includes such animals as the lion, tiger, leopard, jaguar, puma, and lynx. The size and ferocity of the cat tribe vary, but the members have common characteristics: graceful, muscular, fur-clad bodies, feet shod with soft pads and sheathed claws, strong, rough tongues, rounded heads which can be turned in any direction, and eyes that seem to glow in the darkness. Cats cannot see in absolute darkness, but their vision in a faint light is better than that of most animals. In cloudy weather the pupils of their eyes are round and large to admit more light, but in bright sunlight they are reduced to vertical slits.

The biological name *Felis catus* was given to the domestic cat by Linnaeus in 1758. The beginnings of its domestication are lost in antiquity and savages may well have had great trouble in taming its wild ancestors. Its place of origin is also unknown, but it is believed that the Phoenicians, who carried it from Egypt as a valuable animal for trading, are responsible for its wide distribution throughout the world. In various countries *Felis catus* interbred with native wild cats and thus gave rise to breeds of new form and colours.

In geologically ancient times, a land connection between Spain and Africa permitted the "Kaffir" cat (a more powerfully-muscled version of our domestic species) to roam over north-east Africa and a considerable part of Europe. This Kaffir cat is believed to be one of the first of our pets' tamed ancestors.

Among the different types of domestic cat, the smooth-haired Siamese, with brown face, legs, and tail, cream-coloured body, and light blue eyes, commands the highest price: the beautiful, long-haired Angora or Persian cat is supposed to come from Tibet. How and when the tailless cat reached the Isle of Man is not known. Some say it first appeared in Cornwall, others that it is descended from the mascot of one of the ships of the Spanish Armada which was wrecked on the island. Others put its taillessness down to a biological peculiarity. In this category belong the white-haired, pink-eyed albinos, once erroneously thought to be deaf, cats with "double paws" or polydactylism, and the Mexican "hairless" cat, now thought to be extinct.

The word "cat" occurs in many different languages but "puss" is derived from Pashta (or Bast), the cat-goddess which was worshipped by the ancient Egyptians some thousands of years B.C., probably because cats kept the country's grain-stores free from rats and mice. Figures and paintings of the period depict cats wearing earrings and jewelled collars, and their carefully embalmed bodies have been found in tombs. When a cat died, it was customary for the members of its ancient Egyptian household to shave off their eyebrows in mourning.

After the downfall of cat-worship in Egypt, it appeared elsewhere in India, China, and Japan, and "cat clans" sprang up in Teutonic, Celtic, and other lands. Pictures of the Norse goddess Freya show her chariot drawn by two cats.

In later centuries the cat often suffered persecution because of its association with witchcraft. It was thought to have magic powers, probably as a result of its intelligence, its luminous eyes, the electricity in its fur, and perhaps its unearthly voice! The witch's cat was supposed to speak the language of its mistress, and one witch, Moll White, possessed a tabby reputed to have spoken in English on several occasions.

The average age of the cat is reckoned as 14 years, but many reach 18 or 19 and some have lived well past their thirtieth year.

The charm and intelligence of individual cats have made them famous in literature and history. Artists like the Swiss, Steinlen, and the Japanese, Foujita, have delighted in drawing them.

A WILD CAT AND SOME OF ITS DOMESTICATED COUSINS

Most of our domesticated cats are descended from wild cats and in the course of being tamed by man have developed new traits of character and certain physical differences. The wild cat (top left) still exists in parts of Scotland. The Manx or tailless cat (top right) comes from the Isle of Man, but is also native to the Far East. Two common species are the long-haired brown tabby (centre left) and the silver tabby (centre right). The Siamese cat (bottom left) was introduced into Europe fairly recently. The white Persian (bottom right) is popular.

The poet Thomas Gray pens a charming picture of his cat admiring her own reflection in his poem " On a favourite cat, drowned in a tub of gold fishes."

> Her conscious tail her joy declared ;
> The fair round face, the snowy beard,
>   The velvet of her paws,
> Her coat, that with the tortoise vies,
> Her ears of jet, and emerald eyes,
>   She saw ; and purr'd applause.

The Prophet Mahomet held his cat while he preached and Cardinal Wolsey gave audiences sharing his throne with his pet. Charles Dickens's deaf cat often put out her master's candle to make him pay attention to her, and Dr. Johnson's habit of buying oysters for his "Hodge" horrified Boswell.

Puss-in-Boots, Dick Whittington's cat, and the Cheshire Cat in Alice are familiar figures in most nurseries. The British government officially employs a large number of cats, and a weekly " wage " is provided for them.

The cat's aloof and aristocratic nature is sometimes misunderstood by human beings. As the French writer Théophile Gautier has said, he does not lightly confer his friendship : " If you are worthy of his affection, a cat will be your friend

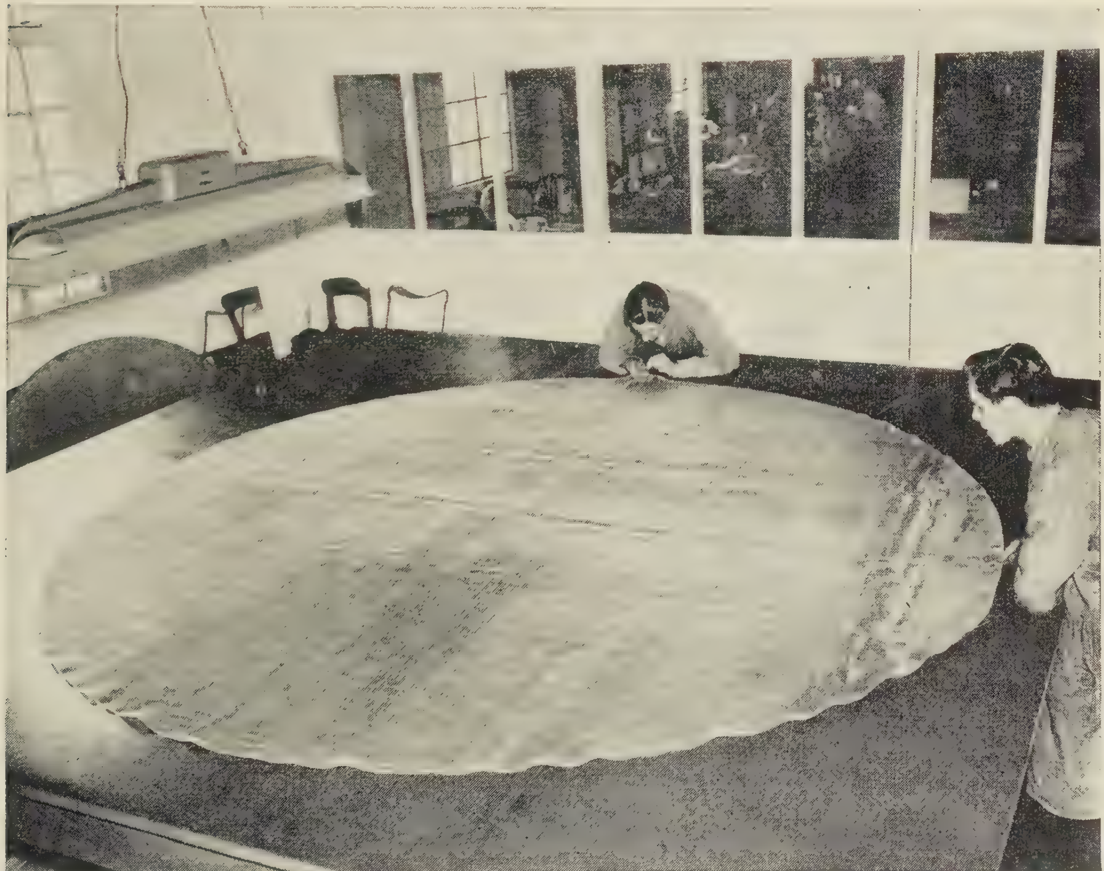
but never your slave." Though extremely sensitive to ill-treatment, he cares little for dislike, though capable of great affection. Rudyard Kipling's "cat who walked by himself" is typical of the whole breed.

Catalyst. A catalyst is a substance which assists a chemical reaction without itself being changed. An example is the oxides of iron which are used to quicken the combination of nitrogen and hydrogen in the making of ammonia.

Caterpillar. The second stage in the life-history of butterflies (see article) and moths is that of being a caterpillar. Hatched from a tiny egg, the caterpillar has an appetite out of all proportion to its size, and it proceeds to eat so much that it soon outgrows its original skin. It then casts the skin and grows a new and ampler one. The caterpillar goes on eating, and repeats the process of moulting until it is fully grown. After a few weeks as a caterpillar (in some species many months) it becomes a pupa or chrysalis; and the pupa in due course releases the fully developed butterfly or moth. Other insects undergo similar changes of form (called metamorphosis), but only the larvae of butterflies and moths are called caterpillars. They vary greatly in size, form, and colouring. Some are large and rather fierce-looking (like a puss-moth larva), while others are smaller and furry, like the common yellowish-brown "woolly bear" (caterpillar of the tiger moth). Many are brilliantly coloured.

All caterpillars have three pairs of jointed legs, situated on the three segments behind the head. They also have several pairs of jointless legs, rather stout and fleshy, upon the abdomen, called pro-legs. There are usually four pairs along the body and one pair at the end, termed anal claspers. But one or more pairs may be missing—as is the case with stick or looper caterpillars (as of the swallow-tailed moth and the little brimstone moth), which must move by catching hold with the front legs and looping up the rest of the body to them, the hind pairs then taking hold and the body stretching forward again for a repetition of the process.

Caterpillars breathe through air tubes (tracheae) opening as tiny pores along the sides of the body. Vegetable substances are their usual food, and in most cases each species prefers certain kinds of plant to feed on. Some do great damage to trees by stripping them completely of their leaves. The caterpillar of the common goat moth eats the wood of a tree, in a tunnel of which it may live for three or more years before becoming a pupa and then a moth. Other caterpillars do enormous damage to



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PRECIOUS METAL USED AS A CATALYST

The carpet is really a sheet of gauze, 9 feet 6 inches in diameter, made of an alloy of 95 per cent. platinum and 5 per cent. rhodium. It is used to make ammonia unite with oxygen at a temperature of about 850° Centigrade. The resulting oxides of nitrogen are dissolved in water to form nitric acid, or combined with milk of lime to make a calcium nitrate.

textiles, not by the amount they eat but by making small holes which ruin the material, as with the larvae of the clothes moth.

Some caterpillars when ready to go into the pupal stage spin about themselves a cocoon of silk, which is produced from glands in the body, and is spun out of an opening in the lower lip. This comes out as a sticky fluid, which hardens on exposure to the air. In this way the silkworm provides the raw material for making silk (see article). Inside the cocoon the caterpillar turns into a chrysalis. Other kinds make a cocoon of leaves, bound together by silk; or simply crawl into a hole in the ground, or under a log or stone, or into a crack in a fence-post or tree.

FRESH-WATER CATFISH

Catfish, so-called from the resemblance of their barbels to the whiskers of a cat, are smooth-skinned scaleless fish. Some species live in the sea, but most are found in fresh water in the Americas, Asia, and Africa.

Catfish. The fishes of the sub-order *Siluroidea* are called catfish from the resemblance of their barbels to the whiskers of a cat. The barbels are set around the mouth, and with them the catfish explores the bottom of the river for its food. Some catfish live in the sea but most are found in the fresh waters of the Americas, Africa, and Asia.

The wolf-fish, *Anarrhichas lupus*, which is often caught by the Arctic trawlermen, is known to them as catfish or sea-cat. It has an ugly head and powerful jaws and teeth with which it crushes the shell-fish that form much of its food. It is related to the small blennies, but it may grow up to a length of four feet.

Cathedral. Early in the Middle Ages any church which contained the official seat or throne (*cathedra*) of an archbishop or bishop was known as the *ecclesia cathedralis*, or church of the seat. As time went on this term was shortened, and such a church became known as a cathedral.

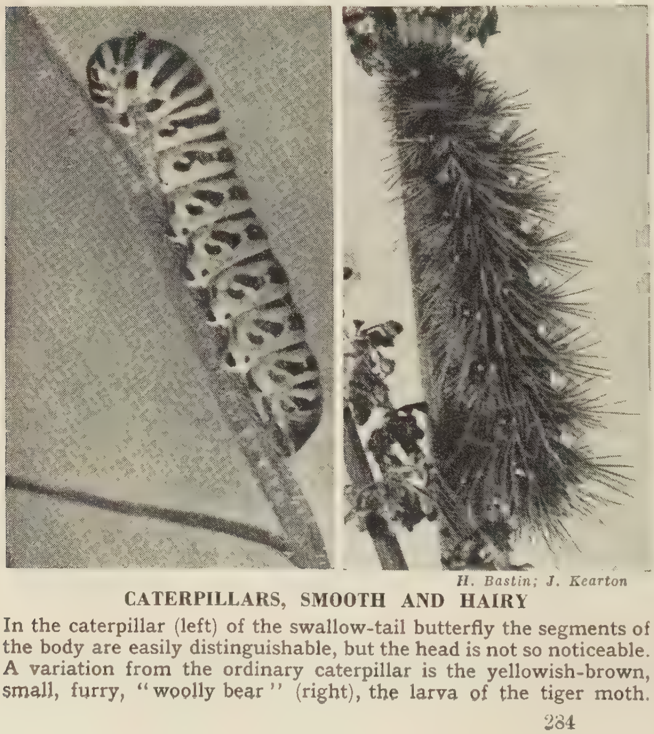
In those days there was only one Church in western Europe, namely the Roman Catholic Church, and the unity of spirit which this fact implied found expression in the desire of people to build churches which would not only glorify God but be a credit to their particular locality. The bishop's church, or cathedral, was almost invariably the largest and finest in the bishop's district or diocese.

As a result of this inspired labour of the "age of faith" there are to-day all over western Europe great and impressive medieval piles whose roofs and towers still dominate the countryside. In the magnificent Gothic cathedrals of northern France, dating from the 12th to the 15th centuries, the tall, pointed window openings are filled with pictures in stained glass, so that rich and varied colours add to the splendour of the interior. Within and without, the sculptor's art has decorated them with figures of men, animals, and plants. Artists have vied with one another in representing the history of humanity and of Christianity, scenes from the Bible, figures of the saints and angels, and symbols of the virtues and vices.

These beautiful monuments to the piety of the Middle Ages were not built in a day. The construction of such cathedrals as Notre Dame of Paris, St. Mark's at Venice, and that of Canterbury stretched out through hundreds of years. So well, however, were the medieval cathedrals built that most of them still stand to-day. St. Paul's Cathedral in London is a later structure, dating from 1675, and is built in a later style.

The building of new cathedrals virtually ceased with the close of the Middle Ages, but was revived to some extent at the beginning of the 20th century. The Church of England began a large new cathedral at Liverpool in 1903 and a smaller one at Guildford, Surrey, in 1936. Coventry cathedral, destroyed by German bombs in 1940, is being rebuilt. The Roman Catholic cathedral at Westminster was opened in 1910, and Roman Catholic cathedrals were also built at Leeds and other places.

The life of an English cathedral city,



H. Bastin; J. Kearton

CATERPILLARS, SMOOTH AND HAIRY

In the caterpillar (left) of the swallow-tail butterfly the segments of the body are easily distinguishable, but the head is not so noticeable. A variation from the ordinary caterpillar is the yellowish-brown, small, furry, "woolly bear" (right), the larva of the tiger moth.

[Continued on page 293

MAJESTY OF THE ENGLISH CATHEDRALS

O. A. F. Kersting

By the side of the river Avon as it flows through Salisbury stands the cathedral, one of the gems of Early English Gothic architecture. It is the only English cathedral of uniform design, for it was built between 1220 and 1258 with the exception of the spire—404 feet in height, the tallest in England—which was added a century later. The cathedral stands in a grassy close surrounded by mellow red-brick buildings, among which is the Bishop's Palace.

J. Dixon-Scott

Lincoln cathedral is one of the most magnificent ecclesiastical buildings in England, and is fully worthy of its commanding position. It stands on a hill in the centre of the city, and can be seen from a distance towering over the roofs below. It was built chiefly in the 13th century, but has undergone a complete restoration. One of its chief beauties is the west front, with its Norman arches, elaborate stone carvings, and, set above the main doorway, statues of eleven English kings. The central tower (260 feet) houses the bell, Great Tom of Lincoln.

WORCESTER CATHEDRAL, BESIDE THE SEVERN

John H. Stone

On the river bank at Worcester stands the Gothic cathedral of Christ and St. Mary the Virgin, which dates from the 13th century but was extensively restored between 1854 and 1874. The central tower, 196 feet high, was completed in 1374. Two of the pinnacles underwent repairs in 1949. The transepts are Norman and Perpendicular in style, and beyond the crossing is a screen, designed by Sir Gilbert Scott, which cuts off the chancel. Under the choir and aisles is a crypt built by St. Wulfstan in 1084. Tombs include those of King John and Arthur, son of Henry VII.

Herbert Felton; J. Dixon-Scott

Canterbury cathedral (upper picture) is the oldest, one of the most beautiful, and certainly the best known of all English cathedrals, for its story is closely interwoven with the nation's history. It was founded by St. Augustine in 597, but construction of the present edifice was not begun until 1070, and the church was not completed until 1495. It is here seen floodlit. St. Albans Abbey (lower picture) is mostly Norman, but was severely damaged at the Restoration. Repairs, begun in 1856 under Sir Gilbert Scott, were completed by Lord Grimthorpe (1816–1905).

GLORIOUS WEST FRONT OF YORK MINSTER

Frith & Co.

York Minster is the largest medieval cathedral in England, and quite apart from its size, is a building of great historic and architectural interest. On either side of the splendid west front, seen here, rises a tower, and in that on the right is the famous bell called Great Peter. The central tower, which rises to a height of 198 feet, and the two smaller towers were completed towards the end of the 15th century. The glory of the minster is the series of stained-glass windows, some of them the finest in England. The glazing of the "Five Sisters" dates from the 13th century.

ELY, ARCHITECTURAL HISTORY OF FIVE CENTURIES

J. Dixon-Scott

Begun in 1083, Ely cathedral was not completed until 1533, and so it includes examples of every style of architecture from Norman to Late Perpendicular. With the exception of the top and the turrets, the tower, which is of unusual design, belongs to the Transition period. The effect of the west front, which is seen here, is somewhat spoilt by the absence of the north-west transept. The original central tower collapsed in 1322, wrecking the Norman choir. The Lady Chapel is on the north side of the choir, instead of being placed in its customary position at the eastern end.

DOMINATING BEAUTY OF DURHAM CATHEDRAL

Photochrom

Like Lincoln cathedral, that of Durham stands on high ground, which allows its beauty to be realized to the full. It is here seen from across the river Wear, which flows round the base of the hill on which the cathedral is built. This great edifice is of Norman and Early English architecture and was begun in the 11th century, though there had been a cathedral in Durham before that time. Notable features are the central tower, the Chapel of the Nine Altars, and the Galilee Chapel. The central tower, here seen behind the two western ones, is 218 feet in height.

WELLS CATHEDRAL, PERFECT BLEND OF STYLES

Frith & Co.

Though Wells is one of the smaller cathedrals, it is also one of the most beautiful, and its surroundings are in accord with it. Here the east end, with the Lady Chapel, choir, and central tower, is seen across the moat of the Bishop's palace. Across the whole of the west front stretch three tiers of sculptured figures in niches, in all 305 statues larger than life-size. The cathedral, which was built mainly in the 12th and 13th centuries, is considered one of the finest in England. The central tower, of Early English and Decorated architecture, is 182 feet in height.

especially of the smaller kind, centres on the cathedral, which may dominate the ways of thought and even the habits of its people. Many residents in the town have direct or indirect connexion with the cathedral. Besides its choir, its bell-ringers, its sextons and vergers, its staff of cleaners, and so on, there are many church dignitaries of various ranks attached to it. First of all there is, of course, the bishop. But the bishop is not the direct governor of a cathedral; the dean and canons form a sort of council in control of the building and the form of its services.

The dean is the most important of the dignitaries; after him comes the precentor (from a Latin word meaning a leader of the singing), who arranges and controls the services and the music (and cathedrals have always been great musical centres). Next comes a chancellor, a sort of secretary who is also the overseer of the cathedral school (if there is one) and the choirboys. And there is a treasurer, who looks after the finances and the fabric of the building. These four important personages usually live in the "close," a group of houses within the precincts of the cathedral. Other people of importance are the canons, of whom some (canons in residence) live in the town but more (prebendaries) live elsewhere, visiting the cathedral once a year to preach. All these dignitaries have special seats or stalls in the choir. Canons and prebendaries form the "chapter," which, under the presidency of the Dean, manages all cathedral business.

B. C. Clayton

CATHEDRAL NAVE AT DURHAM

Durham Cathedral was begun in the 11th century, and much of it is Norman; this includes the nave (above) and the restored chapter house. The nave is that part of a cathedral or church west of the chancel where the congregation sits. There are usually aisles at either side.

The services, which in an ordinary parish church are usually held only on Sundays, are celebrated every day in a cathedral, whether there is a congregation or not; and a peaceful and beautiful way of spending an hour on a winter's afternoon is to attend evensong in the dim nave of a great cathedral, with the choir singing and the canons chanting in the distance under a great east window, and the faint rays of the setting sun lightening the gloom. Or of course, even when there is no service, these solemn, age-old precincts are a refuge from the noise and hurry outside.

Most vivid, interesting pictures of life in English cathedral cities have been drawn by Anthony Trollope in his series of novels about the imaginary county of Barsetshire and its cathedral at Barchester; and by Sir Hugh Walpole (himself the son of a bishop) in his stories about the equally fictitious Cornish city of Polchester; while Charles Dickens made Rochester Cathedral, thinly disguised as Cloisterham, and its immediate surroundings, the setting for his last, unfinished story, *The Mystery of Edwin Drood*.

Cato, Marcus Porcius (234–149 B.C.). *Delenda est Carthago* (Carthage must be destroyed) —these are the famous words most associated with Cato, the Roman statesman, for he always ended his speech with them whenever he spoke in the Senate, whatever was the subject under discussion. He had been so impressed by the wealth of Carthage (Rome's great rival city in North Africa) when he had visited it that he believed that Carthage would destroy Rome if Rome did not first destroy her rival. Though he was laughed at, his fears were justified in the year of his death, when the Third Punic War (149–146 B.C.) broke out; in 143 Carthage was razed to the ground and Cato's wish came true.

Born at Tusculum, the son of a small landholder, he served, when only 17, at the siege of Capua, and later in the Second Punic War (218–201 B.C.). He was made praetor (magistrate) in 198 B.C. and went to Sardinia; on his return to Rome he became consul in 192 B.C. In 184 B.C. he was made censor, and fought against extravagance and luxury.

Cato was stern to a fault, but strictly just, and carried out himself all the restrictions that he imposed on others, punishing those who failed to observe them, without fear or favour, treating rich and poor with equal severity. Cato the Censor, as he is called, was the first Roman historian, though only one of his works, a treatise on agriculture, has been preserved. (*See* Carthage.)

MOST USEFUL *of* DOMESTIC ANIMALS

Cattle. With the buffaloes and bison, cattle form the family *Bovidae*, of the order *Artiodactyla*, which includes sheep, goats, antelopes, the musk-ox, and all the other ruminant animals. The zoological name of farm cattle is *Bos taurus*.

A peculiar digestive system enables cattle to use coarse feeds, called roughage. The stomach consists of four compartments, and in large animals has a capacity of about 60 gallons. The food goes into the large first stomach or pouch, where it is softened, and then overflows into the smaller second stomach. From either of these pouches the food may be returned to the mouth in small portions for rumination, or "chewing the cud," as it is termed. That is why cattle are called ruminants. The food is again swallowed, and goes into the third, and then into the fourth or true stomach. Cattle have no teeth at the end of the upper jaw, and in grazing the vegetation is pulled, rather than cut off, by the pressing of the lower incisor teeth on the tough pad of membrane covering in the upper jaw.

First Domesticated Cattle

Cattle first appeared in India and Europe in early Pliocene times. The Indian species (*Bos indicus*) was the ancestor of the zebu and other humped types of cattle which are found in India, Africa, and elsewhere in the East. Whether the domestic cattle of to-day are descended from the European species (*Bos primigenius*, the urus) is a matter on which zoologists remain uncertain.

Originally cattle were simply beasts to be hunted for their meat and skins. It is probable that they were first tamed in the valleys of the Nile and the Euphrates and in Palestine, where it is believed that agriculture had its beginnings about 12000 B.C. It was not until about 3000 B.C. that cattle were domesticated in Britain. They were small and slender, probably black. Similar beasts were brought over by the Celtic invaders; the Romans introduced larger, white cattle, perhaps the ancestors of the white animals found in Italy to-day; large, chiefly red, cattle came with the Angles and Saxons; the Danes are believed to have brought polled (hornless) animals, of the dull, greyish-brown colour called dun; and the Normans perhaps brought the ancestors of the Hereford.

From this mixture of animals have been evolved most of the modern British breeds—the exception is the British Friesian. But scientific breeding, to produce cattle which will give either high yields of beef or milk, or a combination of both, was not to come for many centuries. Until about 1650, cattle in England were draught animals, used for pulling ploughs or carts—they still are in many parts of the world, including some European countries—and for this purpose they were bred to be strong, heavy beasts of a type unsuitable for good milk or beef production. When too old for work, they were killed for food. Much of the "roast beef of Old England" must have been uncommonly tough!

Scientific breeding of cattle in the United Kingdom began in the 18th century (*see* AGRICULTURE), and its chief object was to improve the quality of meat. Breeding for dairy purposes did not come until much later. Robert Bakewell and the two Colling brothers were outstanding as early breeders of beef cattle. The Collings were the founders of the modern Beef Shorthorn, which ranks with the red and white Hereford and the black Aberdeen Angus as one of the world's best producers of beef. These three famous breeds, exported to all the principal beef-raising countries, have been chiefly responsible for earning Great Britain its title of "the stock-farm of the world." Most of the vast herds in the great cattle-ranching areas of Canada, Australia, the United States, and some parts of South America are based on them.

Other well-known beef breeds are the black Galloway, polled and curly-coated; the shaggy, long-horned Highland (or Kyloe); and the three red breeds, North Devon, Beef Lincoln Red Shorthorn, and Sussex. Some "dual-purpose" cattle, described later with the dairy breeds, also produce excellent meat.

On the prairies and pampas of the Americas great herds of beef cattle graze all the year round—they get all the food they want from the grass. British farms are too small for big herds, and the climate does not produce sufficient grass for the whole year. But by improved methods of grassland management, including generous applications of fertilisers and the use of movable, electrically-charged fences which control the grazing of cattle, Britain's "grass season" is now being extended. This means that more beef can be fed and "finished" quickly on lush pasture and, in the winter, fed on grass products such as silage, a sort of pickled grass which is cheaper than foods such as mangolds. Nowadays butchers like lean beef weighing about 10 cwt. and ready for slaughter shortly after 2 years old.

Seven Important Breeds

The dairy cow is, of course, a very different animal from the heavy, well-rounded beef beast. She is lean and almost wedge-shaped—this is illustrated particularly well by the Ayrshire cow in the picture. Most of the breeding for high yields of milk has been done during the present century. A good dairy cow will give well over 1,000 gallons a year, and some yield as much as 4,000 gallons. (*See* DAIRY FARMING and diagram.)

Of the seven breeds which form the vast majority of British dairy herds, three—Guernsey, Jersey, and Ayrshire—are purely dairy types and do not fatten well for beef. Guernseys and Jerseys take their names from their native Channel Islands; their milk (see article) is particularly rich in butter-fat. The Jersey, with its fawn, fawn and white, silver-grey, or sometimes almost black coat, is perhaps the most attractive-looking of all British cattle. It is much smaller than the Guernsey, which is also fawn in colour but with white patches on the legs and often on the body too. Ayr in Scotland is the home of the Ayrshire breed, usually

CHAMPION CATTLE OF EIGHT NOTED BREEDS

"Farmer and Stockbreeder"

Great Britain and the Channel Islands are renowned for their cattle. The Hereford bull (top left) provides first-class meat, as does the black hornless Aberdeen Angus (top right). In the next row are a Dairy Shorthorn cow (left), a dual-purpose animal, and a Highland bull (right). The third pair comprises two breeds noted for their rich milk—the Guernsey (left) and the Jersey (right). Ayr in Scotland is the original home of the Ayrshire (bottom left), a dairy breed. The British Friesian (bottom right) has a bigger annual yield of milk than any other breed.

mahogany-red and white in colour. These Ayrshires give high yields of excellent milk.

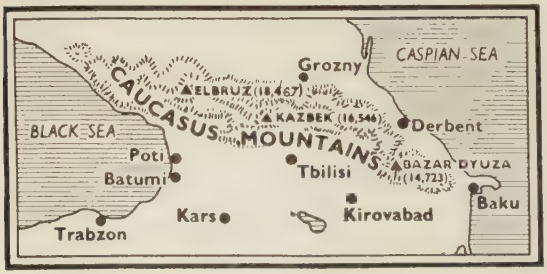
The black-and-white British Friesian gives a very high yield of milk. Unfortunately, the percentage of butter-fat in the milk is fairly low, but steps are now being taken to improve this. Although essentially a dairy breed, the Friesian can produce quite good beef. Originally imported from the Netherlands, it is still known in Canada and the United States as the Holstein.

The Dairy Shorthorn is the best-known and most numerous dual-purpose breed. The females are excellent milkers and practically all the males are fed for beef. Dairy Shorthorns (and Beef Shorthorns) are mostly red or roan in colour, and sometimes white. Less common are the dual-purpose Dairy Lincoln Red Shorthorns and the hornless Red Polls. The large, red, curly-coated South Devon ranks with the Guernseys and Jerseys as a producer of milk with a higher percentage of butter-fat than the other dairy breeds. It also makes excellent beef. The Welsh Black, the Kerry, and the Dexter are other less well-known breeds, kept chiefly in their own localities. The Dexter is the smallest of all British cattle—the saying is that "you must sit on the grass to milk it"!

People are sometimes puzzled at some of the different terms used to describe types of cattle. "Ox" and "oxen" were formerly used as terms for all cattle, but rarely is this so to-day; oxen, if used at all, has come to mean those male animals which are not used for breeding but are fattened for beef: farmers call them bullocks or steers. A calf is a young animal of either sex, of which the flesh is called veal. A young female is a heifer calf. She remains a heifer until she has had her second calf, when she is known as a cow. "Store cattle" are animals which are in the process of being fattened for beef; when ready, or nearly ready, for slaughter, they are called "fat cattle."

Caucasia (pron. kawkā′zhia). This region, lying between the Black Sea and the Caspian Sea, was for long a land of poetry and romance. Here, according to Greek legend, was the mountain where the Titan Prometheus was punished for stealing fire from heaven, and also the valley of Colchis, the goal of the Argonauts (see article) in their search for the Golden Fleece.

In the north of the area are the Caucasus Mountains (pron. kaw′k*asus*), extending more than 750 miles. The range varies in width from 30 to 140 miles and in the central part are several peaks rising to over 16,000 feet; these include Elbruz (18,467 feet), Dykhtau (17,054 feet), Koshtantau (16,881 feet), and Kazbek (16,546 feet). In some places the side of the range is like a wall of stone, more than half a mile high. Forests cover the lower slopes, while the summits are capped with snow and ice, and there are numerous glaciers. A depression running from Batum and Poti on the Black Sea coast to Baku on the Caspian separates these mountains from the ranges of the Little Caucasus.



Caucasia is part of the U.S.S.R., though it is the home of many different peoples besides Russians. Among these are Cossacks and Circassians in the north, and Georgians, Armenians, and Tartars in the south. All these peoples have their own ancient culture, their songs and dances and traditions, to which they still cling. Russia completed the annexation of almost all the region in 1878. In order to govern the territory south of the mountains the Russians constructed a great military road connecting Stavropol (Voroshilovsk) and Tiflis (Tbilisi) by way of the Kobi Pass and the deep chasm of the Davial Gorge.

Following the Russian revolution of 1917, the territory north of the Caucasus Mountains became part of the Russian Soviet Federal Socialist Republic; and the region south of the range was organized as the Transcaucasian Soviet Federal Socialist Republic, but this federation was abolished in 1936, separate Soviet Republics being formed for Azerbaijan (capital Baku), Georgia (capital Tbilisi), and Armenia (capital Erivan). Joseph Stalin, head of the government of the U.S.S.R. from 1924 until his death in 1953, was born Joseph Vissarionovich Djugashvili at Gori in Georgia in 1879.

There are rich deposits of copper, silver, iron, cobalt, sulphur, quicksilver, and manganese. The Georgian manganese deposits are among the richest in the world. Oil is especially important in the neighbourhood of Baku in Azerbaijan. Most of the commerce of the region passes through the seaports of Batum, Poti, and Novorossiisk (in the North Caucasian area) on the Black Sea, and Baku and Derbent, on the Caspian. Batum and Baku are connected with each other and with the rest of Russia by railway. An oil pipeline runs from Baku to Batum.

The name "Caucasian" is sometimes given to the white division or branch of mankind.

Cave. After exploring Wookey Hole, near Wells, in Somerset, or the near-by caves of Cheddar, anyone can easily understand why such great dark, hollow places in the earth have in all ages excited the awe and wonder of mankind.

These caves are remarkable for their glistening stalactites and stalagmites. Stalactites are the stony pendants hanging like icicles from the roof; stalagmites are similar forms rising in columns and cones from the floor. The water, finding its way drop by drop through the limestone roof, falls and leaves behind carbonate of lime. Thus a stalactite begins to grow from the roof downward. The drops deposit more "lime" as they splash on the floor, and so a stalagmite is formed. In some cases stalactites and their stalagmites grow towards one another until they meet, forming solid pillars.

One might wander about for days in Mammoth Cave, in Kentucky, U.S.A., meeting wonders at every turn, for it extends 10 miles or more underground, and is the world's largest cave. Another world-famous cave is the Blue Grotto on the Isle

[*Continued on page* 301

CAVERN OF COLOURS IN THE MENDIP HILLS

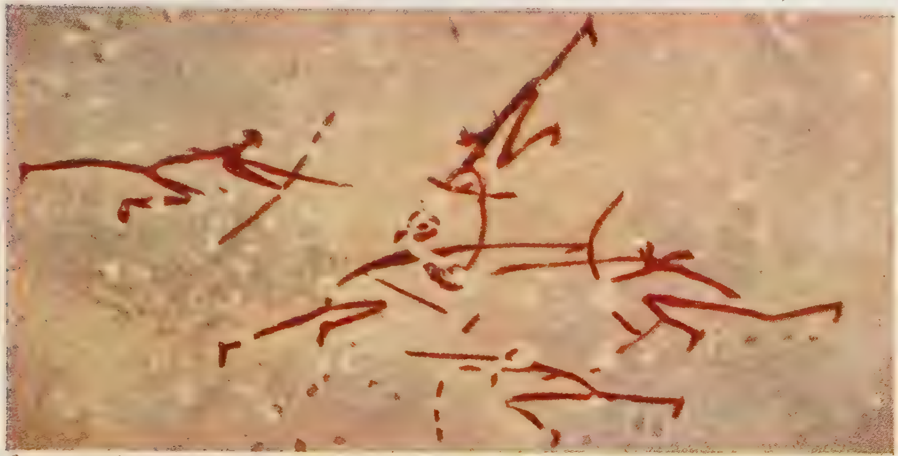
Valentine

Limestone country is usually rich in caves, because limestone rock is soluble in water, and the water cuts out hollows as it flows in a subterranean stream. In Cox's cave at Cheddar, Somerset, artificial lighting illumines the colours of the minerals in the rock and reveals the weirdly shaped stalactites and stalagmites, which are reflected in the water.

BEAUTY OF LIGHT AND COLOUR IN THE FAMOUS BLUE GROTTO

In the Blue Grotto, Capri, the small island in the Bay of Naples, has a natural marvel almost without parallel in the world. There are other caves in which effects are attained by stalactite and stalagmite formations coloured by chemicals, but the beauty of the Blue Grotto is due solely to the purity of the water within and the brilliance of the sunlight outside. Just as when seen through blue glass all objects appear blue, so they are tinted in the grotto by the clear light passing through the blue water.

CAVE DRAWINGS OF DAILY LIFE 12,000 YEARS AGO



These drawings, made by ancient cave-dwellers in south-eastern Spain, are valuable as the earliest records of the daily life of primitive man. They are remarkable, too, for their technique. The large illustration is the earliest battle picture in existence ; the figures on the right may probably be hunters, one carrying a bow and arrows, and the other a spear.



Hunting is, naturally, the subject of many cave drawings, as in this scene of deer being driven over a cliff and shot by men with the first-known bows and arrows. The drawing in red alongside is of a man collecting honey, with the bees flying around him


From Cabre, El Arte Rupestre; and Obermaier, El Hombre Fosil

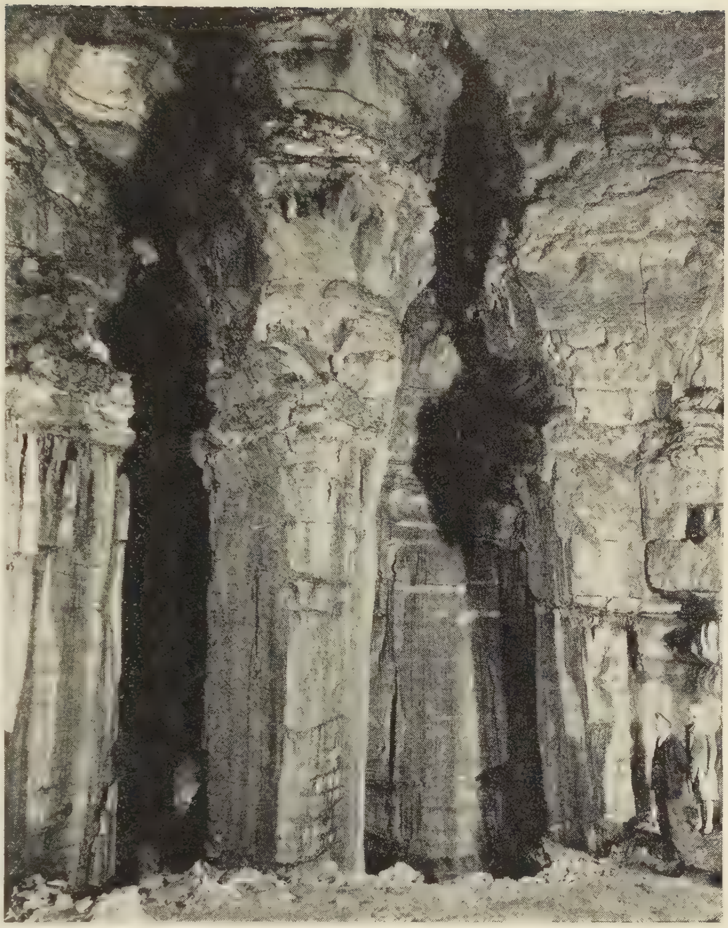
Settled in Spain at a period that may be dated between 14000 and 10000 B.C., the Capsians left in their cave dwellings drawings which prove their possession of a high degree of culture. The group (left) at Cogul, near Lérida, represents perhaps a marriage ; while the male figure (right) in the Alpera caves and the two above him may be ceremonial dancers.

Reconstruction by Charles R. Knight, courtesy of American Museum of Natural History

HOW CAVE-DWELLERS LIVED IN THE PREHISTORIC FLINT AGE

This well-authenticated illustration affords an idea of how some of man's very remote ancestors lived. These are people of what is called the Neanderthal period, the first fossil remains of which were discovered in a grotto of the Neanderthal ravine near Dusseldorf, West Germany, in 1856. Their homes were in caves, often beside lakes or rivers. Their weapons were flints and spears of fire-hardened wood, with which they are here shown preparing to hunt game which is drinking in the river below.

of Capri, off the Bay of Naples. Known to the Greeks and Romans, the grotto was lost to the world until 1826, when it was rediscovered by accident. There are a number of caves along the towering cliffs of Capri, but the Blue Grotto is incomparably the finest. It has only one entrance, and that is through a narrow opening from the sea barely large enough to admit a small rowing-boat. From the deep watery "floor" of the cavern, which is oval and measures 175 feet in length and 98 feet in breadth, a stream of light filters, flooding the grotto with shades of sky-blue and sapphire.



ENTRANCE TO THE MAMMOTH CAVE, KENTUCKY

So far as is known, the largest cave in the world is the Mammoth Cave, Kentucky, U.S.A., which extends underground for some 10 miles. At the entrance are rock formations (above) called the Ruins of Karnak from their resemblance to the columns in the temples at Karnak, Egypt.

Some caves cannot possibly be entered except by expert speleologists (cave explorers) with elaborate equipment. Apart from the Mendips, in Somerset, the "potholes" (holes having long cylindrical entrances) in the Pennine hills of Derbyshire and west Yorkshire are the principal English fields of exploration. They include Gaping Ghyll, in Yorkshire, with a sheer drop of 354 feet. There are adventurous people known as "potholers" who make a sport of these explorations, just as mountaineers do of climbing, but such hazardous expeditions should on no account be undertaken by people not of age.

After visiting these places one can see why legends and superstitions have centred about caves in all ages, as in the Fairy, Dragon's, and Devil's caves of France and Germany, the Grottes de Han in Belgium, and the cave-palaces in the Harz Mountains in Germany, where the Little Men or gnomes were supposed to have lived long after they forsook the forests and glens. Caves were the abode of the nymphs in Roman mythology, and in Greece they were the temples of Zeus, Pan, Pluto, and Dionysus, as well as the seat of the Delphic and other famous oracles which attracted visitors from all parts of the known world anxious to learn their future fate.

More interesting than the legends, however, is the fact that from the remotest periods of history animals and men have inhabited caves, and from the remains left by them men of science have been enabled to read the early chapters in the history of human and animal life (*see* CAVE-DWELLERS). Caves have always been favourite haunts of smugglers, bandits, and others wishing to hide themselves from enemies or from the law. They have even been used as tombs and places of worship.

In India are to be seen some of the finest examples of natural cave and craftsman's skill. In Hyderabad, the Western Ghats, and other hilly districts, are numerous basins and valleys with steep walls of sandstone and limestone. From soon after the death of Buddha, in the 4th century B.C., hermits and monks adopted natural caves in these cliffs as dwelling-places.

The earliest of these cave temples to survive to our day are at Ajanta, in Bombay state. Massive pillars, beautifully carved, support the roof and galleries; there are altars and niches richly carved with figures of the Buddha and his disciples. At Ellora, in the Deccan, are monasteries hewn from the solid rock, forming terraces which in appearance resemble modern blocks of flats. Near by are ruins of an ancient cave temple, from which many finely carved figures have been removed.

At Karli, in the Western Ghats, a ravine which runs for several miles between steep rock cliffs was a favourite haunt of early Buddhists. The action of wind and rain scooped out three natural caves, one above another, and monks lived here for more than a century. Buddhists then enlarged the caves and staircases and terraces so that all three were connected and the monks could go from one level to another within the rock. This is the most perfect example of a three-storey monastery cave temple to be preserved.

One of the grandest natural caverns is Fingal's

The limestone foothills of the Mendip Hills, in Somerset, are riddled with caves and underground streams, the rocks having been eaten away by water impregnated with carbon. One of the largest caves in England is Wookey Hole, through which flows the Axe. The cave is 500 feet long, and in it have been found prehistoric implements and fossil bones of mammoth, reindeer, and woolly rhinoceros. People lived in it up to about A.D. 400.

American Museum of Natural History

Some of the most interesting relics of prehistoric man are the wall paintings found in caves in the south of France, and in Spain and Italy. This picture gives an idea of the difficulties under which an artist of the early Stone Age worked. The painter, standing upright, uses a crude palette on which to carry his pigments, and his only light is that from the smoky lamp of stone or clay held by one of his companions. When the outline has been drawn he fills it in, and gives the effect of shading with colours made of brown, yellow, red, or black earth, mixed with oil.

Cave, on the island of Staffa (see article), the sides of which consist of ranges of basaltic columns. High above the sea in the Rock of Gibraltar are several stalactite caves where remains of Neolithic cave-dwellers have been found. In Iceland and Hawaii are many caves formed by the lava from volcanoes, and in the mountains of central Europe are huge ice caves. Big Bone Cave, in Tennessee, U.S.A., is so named from the bones of the mastodon, a prehistoric type of elephant, which were discovered there. Caves occur chiefly in limestone and chalk formations, because water dissolves these rocks. Sea waves often hollow out caves in a cliff.

Cave-dwellers. Scientists believe that the cave-dwellers of the Stone Age not only were tall and strong with well-formed features but also possessed brains larger than those of many savage tribes of to-day. This fact is important, for the intelligence of peoples is measured roughly by the size of their brains.

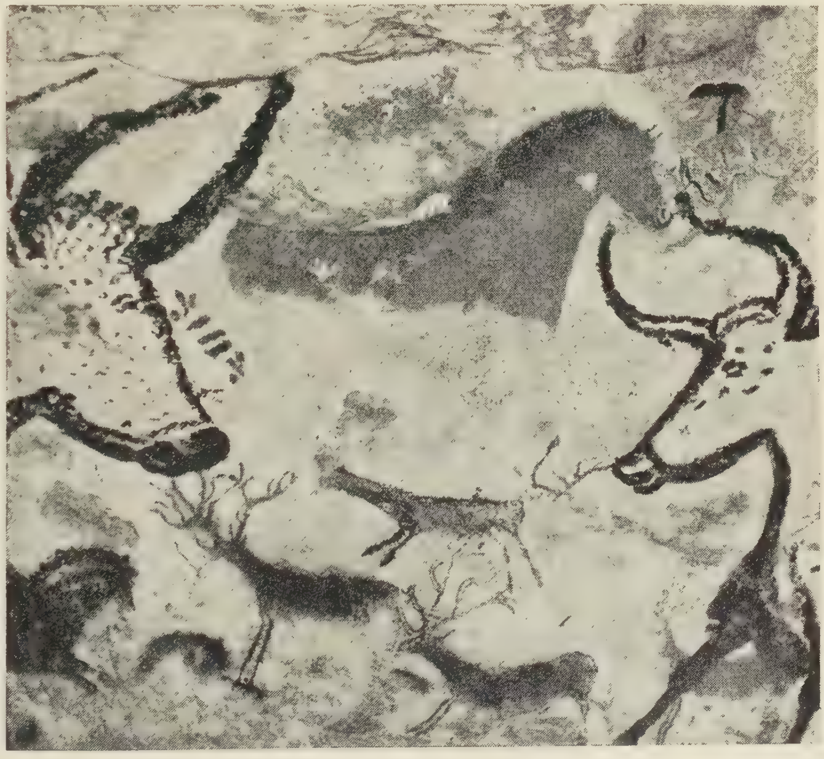
Because the first remains of these old cave-dwellers were found at a spot called Cro-Magnon on the Vézère river in southern France, they are called the Cro-Magnon race, and the first skeleton discovered is known as the Old Man of Cro-Magnon. This "old man" was evidently one of the most intelligent of his day. But his manners were rough. Indeed, the skull of a woman found near his skeleton, presumed to be the skull of one of his wives, has a hole in it, evidently made by a blow from a flint hatchet. But women in those days were hardy, like the men, and the growth of the bone indicates that she recovered from this blow.

Such manners were natural in the midst of the hard life the cave-men led. They were surrounded by wild beasts, which threatened their lives every minute they were away from the shelter of their caves. While hunting the reindeer, the wild horse, and the bison, they were themselves hunted by the lion and the cave-bear, which then inhabited Europe. They were often running a race for their lives with an angry mammoth, a woolly rhinoceros, or a pack of wild boars.

Their other enemy was the cold, for they lived at a time when the ice cap, which now covers only the polar region, had crept right down to central Europe, so they had to endure a climate like that which the Eskimos and Lapps have to live in now. So they were glad to have caves in which to shelter.

Yet these early men found time to draw excellent pictures. The walls of some caves in France, Spain, and Italy are covered with finely carved and painted sketches of the animals which the cave-dwellers hunted. We may picture a Cro-Magnon artist at work on these walls in the long evenings. A friend holds a lamp, made of a bowl of rude clay filled with melted grease, in which floats a burning wick of plant fibre. While the wolves howl outside, the artist tries to remember just how that wounded bull looked when the spear struck him. Then he sets to work as shown in the picture opposite.

The Cro-Magnons were not the first cave-men. Thousands of years earlier, races even more savage, with sloping foreheads and monkey-like faces, occupied these same caves. And thousands of years later the peoples of the New Stone Age replaced the Cro-Magnons. Scientists have learnt much about the early history of man by exploring caves. They dig into the earth floor and there find the bones and stone weapons of one race, buried by the mud of ancient floods and the sand and earth from the damp walls. They dig farther and find another layer of bones and weapons, telling of a still more ancient people. In these layers they find the remains of strange animals long since disappeared. And out of all this the story of the cave-men is woven together bit by bit by the patient scientists who bring these relics to light.



CAVE-DWELLERS' DRAWINGS IN LASCAUX CAVE

Situated on a hill overlooking Montignac, on the river Vézère, southern France, the Lascaux cave was discovered by four boys in September 1940. The walls are decorated with drawings of cows, deer, and horses, painted in black, red, and yellow pigments. Etched with flints, these astounding works may well be some 20,000 years old.

After many thousands of years the ice melted. As the climate improved and Europe became more as it is to-day, a more settled life became possible. Man could now spend the summer in lightly-built huts and needed to retreat to his caves only for the winter. The barbarian races who in time replaced the cave-dwellers had no art, but had learned to tame the wild cattle and herd them with the aid of a wolf-like creature—" man's first friend," the dog. In time these peoples learned to practise agriculture and to use copper and tin. Still later they gathered into cities and built great buildings like the ancient pyramids of Egypt—which are not ancient at all if they are compared with the Old Man of Cro-Magnon who may have lived some 20,000 years ago. (*See* STONE AGE.)

Cavendish, HENRY (1731–1810). If there is one chemical formula that nearly everyone knows it is that for water—H_2O. Cavendish was the first man to mix hydrogen and oxygen in those proportions, and by actual experiment to produce water by that means. He filled a globe with a mixture of the two gases, weighed the sealed vessel with its contents, and exploded the gases with an electric spark. He then discovered that the gas in the globe had ceased to be gas and in its place was water, which, although it occupied a much smaller space than the gas, yet weighed exactly the same. His interpretation of what had happened, however, went astray owing to the fact that he still believed in the " phlogiston " theory—that fire was the visible form of a fluid called phlogiston (*see* CHEMISTRY). His last investigation, known as the Cavendish experiment, consisted of a series of experiments to determine the density of the earth.

This nephew of the 3rd Duke of Devonshire made many discoveries that helped to lay the foundations of modern chemistry. For the first half of his life he was comparatively poor; for the second half, immensely rich by inheritance. He was shy, reserved, methodical, and very eccentric. Apart from the meetings and dinners of the Royal Society (the premier scientific society in Great Britain), he had scarcely any intercourse with his fellow men. He ordered his dinner every day by placing a note on the hall table. He never received strangers at his house, and saw his heir only once a year and then for only a few minutes. His home was filled with apparatus for experiments and research, and he had a separate house for his books, which he allowed any serious student to use freely.

The name of this talented scientist is commemorated in that of the Cavendish Laboratory at Cambridge. In 1871 the Cavendish Professorship in Experimental Physics was founded, by the aid of the 7th Duke of Devonshire, who had given funds for a laboratory and for its equipment. The first Cavendish Professor was the famous James Clerk-Maxwell, who was succeeded in later years by such notable figures in scientific research as Lord Rayleigh, Sir J. J. Thomson, and Lord Rutherford. After Rutherford died, in 1937, Sir William Lawrence Bragg became professor; he is renowned for his investigation of crystal structure by X-rays. Few scientists of the past can have been so worthily commemorated as Henry Cavendish.

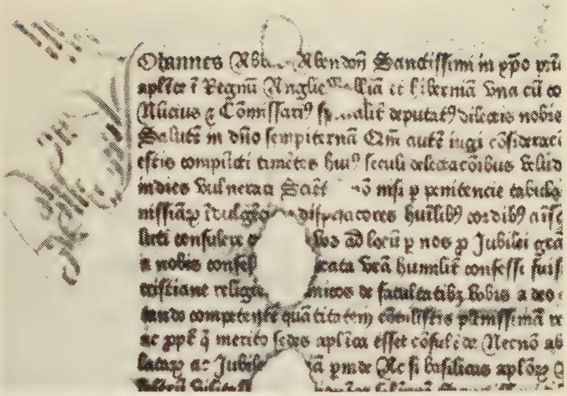
Caxton, WILLIAM (1422 ?–91). The fame of William Caxton rests on the fact that he was the first English printer. But he was over 50 when he began this craft. Starting as an apprentice

CAXTON SHOWING HIS PRINTING PRESS TO EDWARD IV AND HIS QUEEN

In 1476 Edward IV and his queen visited William Caxton and were shown his printing press, set up in the almonry attached to Westminster Abbey, London. Caxton studied printing at Cologne, Germany, and in 1474 printed the first book in English. He returned to England in 1476, and set up a press on a site in London now occupied by the Methodist Central Hall. Of the 99 works published by him, he edited almost every one and translated 25.

to Robert Large, a silk mercer, in 1438, he soon went to Bruges, in Belgium, then the foreign centre of Anglo-Flemish trade. In 1453 he was made a liveryman of his trade guild, the Mercers' Company, and ten years later became acting governor of an association known as the Company of Merchant Adventurers in the Low Countries.

His standing as a business man led to his being appointed to negotiate trade treaties, which, in turn, led to his joining the household of Margaret, Duchess of Burgundy. With her encouragement he began to devote himself to the translation of French books, and in this way was brought into touch with a new Continental invention—printing by means of movable types. Caxton studied the craft first in Bruges, and then in Cologne, where, with a partner named Colard Mansion, he printed two of his own translations, a medieval romance, *The Recuyell of the Historyes of Troye* (1474 or 1475) and *The Game and Playe of Chesse* (1475), the first works to be printed in English.



INDULGENCE PRINTED BY CAXTON

William Caxton (*c.* 1422–1491) was the first English printer, establishing his press in the almonry of Westminster Abbey in 1476. The first known product of this press which he set up on English soil is a Papal Indulgence dated 1476. The Indulgence, seen here, was discovered in 1928.

In 1476, Caxton brought his printing press to the almonry at Westminster. From there, encouraged by the patronage of King Edward IV and his nobles, he produced nearly a hundred books. The first known product of his press is a Papal Indulgence dated 1476; later his prodigious output included service-books for the clergy, tales of romance and chivalry—including Malory's *Morte d'Arthur*—and many of his own translations. He is thus one of the founders of literary English, and as such influenced the form of the language. Caxton gave England a tool for the shaping of thought, a weapon for the battles of discussion, that was to have consequences far mightier than he could ever have foreseen.

Cecil Family (pron. sisl). The story of the Cecil family has been woven into English history for the past 400 years. It is more than a mere history-book name, however, for although several generations of Cecils have specialised in government affairs, this great house has excelled in sundry other fields.

The name gradually takes shape through the Seycelds or Cyssells or Scisselds of the 14th century, until the birth of William Cecil in 1520. He was the earliest notability of his line, and came into prominence under Somerset, protector to the boy king Edward VI. When, at Somerset's downfall, Cecil was also imprisoned in the Tower, he doubtless thought his career already over, but he was eventually allowed to return to court. His great ability was recognized, and under Elizabeth I he became lord high treasurer and the Queen's chief minister, with the title of Lord Burghley. According to Sir Winston Churchill, he was the greatest English statesman of that brilliant period, and served Elizabeth with loyalty for over forty years. She called him her "spirit," and when on one occasion she disapproved of his policy, he needed only to threaten to resign for Her Majesty to change her mind.

National Portrait Gallery

WILLIAM CECIL

Lord High Treasurer of England from 1572 until his death in 1598, William Cecil was created Baron Burghley in 1571, and was for years the loyal, trusted adviser of Queen Elizabeth I.

Burghley was married twice, and each of his wives had a son, so that the Cecil family tree divided into two branches, as it is still traced to-day. The elder of the two step-brothers, Thomas, after a rather wild beginning, settled down to army life. He later became a privy councillor and Knight of the Garter, and was created Earl of Exeter by James I. Nearly 200 years afterwards the tenth earl was made a marquess. Tennyson's poem, "The Lord of Burleigh," was inspired by his romantic marriage to a farmer's daughter. Others in the direct line have won military distinction; the 6th Marquess, as Lord Burghley was a fine athlete.

The "Hatfield" branch (so called from Hatfield House, their family seat) is descended from Robert Cecil, the younger son of Queen Elizabeth's Burghley. Robert was well trained in statesmanship by his father, and in spite of the handicap of being a hunchback he became chief adviser both to Elizabeth in her last years and to James I. It was to a great extent by his help that James acceded to the English throne, and thus united the crowns of England and Scotland; and his services were rewarded with the title of Earl of Salisbury. It was this same Robert who heard the first rumours of the Gunpowder

CEDAR OF LEBANON

As its name implies, the cedar of Lebanon was introduced from the Near East. It is a distinctive tree, with a massive trunk and flat, widespread foliage. Many of these were planted in British parks in the 17th century.

Plot (*see* FAWKES, GUY), and ordered the underground search for the conspirators. For some generations his successors were not greatly distinguished, but the 7th earl, who was lord chamberlain to George III, was created a marquess in 1789.

After a lapse of some years, the family name again came to the forefront in state affairs. The third marquess of Salisbury, Robert Arthur Gascoyne-Cecil (1830-1903), was only 23 when he entered Parliament. During the next 40 years he was three times Conservative prime minister and four times foreign secretary. He had a vast and widespread influence as the outstanding European statesman of his time, and his career spanned much of the long reign of Queen Victoria.

His family of distinguished sons included the fourth marquess, also a politician; Lord Robert Cecil (Viscount Cecil of Chelwood), a strong champion of disarmament and winner of the Nobel Peace Prize in 1937 for his efforts in connexion with the League of Nations; Lord Edward Cecil, noted for his governmental service in Egypt; Lord William Cecil, for many years Bishop of Exeter; and Lord Hugh Cecil, later Baron Quickswood and Provost of Eton. The present marquess, like his father, has been leader of the house of lords, beside holding important government positions; his brother, Lord David Cecil, Goldsmiths' Professor of English Literature at Oxford, is a brilliant writer and lecturer on literary subjects.

Cedar. Some of the largest and most beautiful trees of the pine family are the true cedars, which are all evergreens. The cedar of Lebanon (*Cedrus libani*) comes from Asia Minor, and is mentioned in the Bible as a symbol of long and successful life. The bole or trunk-base grows very thick, and the lower branches grow out horizontally, their tips nearly touching the ground. The main trunk is short, and spreading boughs from the upper branches give the tree a rather flat top. The needle-shaped leaves are greyish green, growing in tufts mostly turned upwards. They are only about an inch long. When about 30 years old, or in some cases much older, cedars produce cones. The slender yellowish male cones shed clouds of wind-blown pollen and then fall off. This happens in autumn in Britain. The female cones are egg-shaped, much smoother than pine cones, and upright. At first greyish pink, they enlarge to about four inches long and turn purplish brown, and only after three years are their winged seeds ready for shedding. The deodar, or Himalayan cedar (*Cedrus deodara*), differs from the Lebanon cedar in having a longer main trunk and therefore a more cone-like shape. In north-west India it can grow as high as 12,000 feet above sea level. The Atlas cedar (*Cedrus atlantica*) grows on the mountains of Algeria and Morocco. It also is cone-shaped, with branches slanting upward and bluish-green or greyish-green leaves. In their native countries, cedars produce strong timber, but British climate forbids this.

The "cedar" wood of cigar boxes and moth-proof chests comes from a very different tree, *Cedrela*, which is not a conifer but a flowering tree of tropical America and the West Indies. The pleasantly-scented "cedar" wood of good-quality pencils comes not from cedars but from junipers, which also yield the so-called cedar-wood oil used in microscope work. The edible seeds of the Siberian "cedar" which is a kind of pine, produce "cedar nut" oil.

Celebes (pron. sel'ēbēz). This oddly-shaped island consists mainly of four peninsulas extending to the east and south, almost like the arms of an octopus, the most northerly arm being much the longest. Celebes is one of the larger islands in the Malay Archipelago, with an area of about 73,000 square miles. To the west, the strait of Macassar divides it from Borneo; to the east lie the Moluccas; and to the north, separated by the Celebes Sea, are the Philippine Islands. The island of Flores lies to the south.

The central and northern parts of the island are mountainous, and there are several active volcanoes. The largest of the many lakes are Posso, Tempe, and Tawoeti. The scenery is varied and picturesque, and the luxuriant vegetation includes extensive forests of oak, teak, and cedar. Though Celebes is on the equator, the climate is tempered by sea breezes and healthier than that of most tropical regions. Among the chief products are

coffee, sugar, spices, rice, maize, palm oil, and tobacco ; and there are deposits of gold, copper, iron, zinc, nickel, salt, and coal, as well as some diamonds and other precious stones.

There are about 5,000,000 inhabitants, chiefly of Malay stock. They are a sturdy, industrious people with a fine tradition of seamanship. In the south, people are Muslims ; while in the centre they are mostly pagans. The capital is Macassar (population 100,000), in the south-western peninsula. It has a fine harbour and a long history as an important trading centre. Manado (population 37,000), on the long north-eastern peninsula, is the chief town of the Minahassa region, where there is a large Christian community. More people in this area are able to read and write than in other parts of the island.

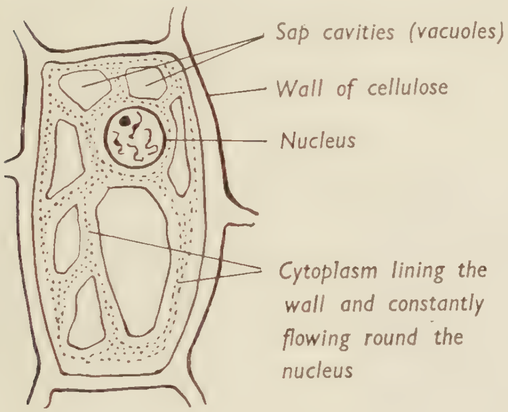
Celebes was visited by the Portuguese in 1512. In 1618 the Dutch East India Company established trading posts in the southern part of the island ; and gradually the Dutch acquired the whole island, annexing it towards the middle of the 17th century. It was occupied by the Japanese from 1942 to 1945 during the Second World War. Celebes (or Sulawesi, as it is now called) became in 1950 one of the provinces of the republic of Indonesia (see article and map). To a considerable extent, the local authorities are allowed to look after the affairs of the island.

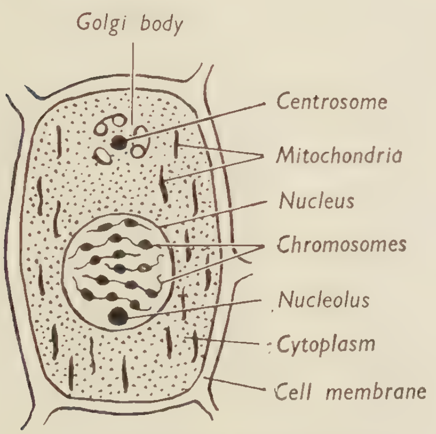
Celery. In ditches and coastal marshes wild celery is fairly common. It is similar to hedge parsley, but coarser, and it belongs to the same family, *Umbelliferae*, distinguished by its flat-topped bunches of tiny greenish-white flowers. The wild plant is unpleasantly bitter, but long cultivation has provided a pleasant-flavoured winter vegetable. The cultivated celery plant is earthed up in a trench, and soot is often mixed with the soil. This keeps its main stem very short, about two inches in length, and makes the leaf stalks grow long and white, or tinged with pink. Only the leaf blades come above the soil and turn green. The ridged leaf stalks and the nutty-tasting stem are eaten, raw or cooked. If left in the earth, the plant sends up flowers and makes seeds. Boiled celery seeds make good flavouring for soup and are said to be good for people who suffer from rheumatism. One variety of celery known as celeriac produces a large, turnip-like root with a milder taste than the ordinary turnip. The scientific name of celery is *Apium graveolens*.

Cell (Biology). Every living thing is built up of microscopic units of living matter and of substances made by them. The units are called cells (Latin *cella* means a small room). Nearly all cells are so small that they have to be measured by the scientist's unit μ, which means 1/1,000th of a millimetre. A red cell in human blood is about 7μ across, and a cell from the juicy part of an apple measures 40 to 50μ. The study of cells is called cytology, and it began when the microscope was invented. It has since made great strides, using the ultramicroscope, the electron microscope, and the marvellous, delicate, mechanically controlled glass needles, as fine as spider threads, which prick and cut the cells that are being magnified.

Human, animal, and plant cells are of many different shapes, sizes, constructions, and uses, but some simple examples can be studied with the help of the diagrams. Each cell has two kinds of the living matter called protoplasm (see article). One kind forms a ball, called the nucleus (plural nuclei), usually in the centre ; the rest is called cytoplasm. They differ in the various kinds of protein and other chemical substances they contain, but both are rather like a newly-made jelly, set on the outside, but liquid inside. These more solid boundaries, called membranes, keep the nucleus distinct from the cytoplasm, and the cells—especially in animals—distinct from each other. In plants the cytoplasm makes itself a thin transparent case or cell wall of a substance called cellulose. Animal cells, except for those composing glands, rarely have spaces in their cytoplasm, but plant cells soon begin to collect a watery liquid, the cell sap, and develop cavities called vacuoles to hold it. The thinnest imaginable threads of cytoplasm, invisible under the ordinary microscope, connect each cell with its neighbours, passing through the cell walls in plants.

In living cytoplasm of animal cells small granules and matchstick-shaped objects called mitochondria were discovered many years ago. Those discovered much later in plant cells are





PLANT AND ANIMAL CELLS

In the centre of the living cell of an animal (lower diagram) is the nucleus, which contains the chromosomes. The rod-shaped mitochondria are believed to be connected with the production of proteins. In the plant cell (upper diagram) the nucleus resembles that of the animal cell, but there are no mitochondria or Golgi body.

smaller and very faint. There is still a great deal to find out about their work, but they seem to be concerned with the complex chemical changes needed to build up protoplasm from food substances and to break it down by respiration to release the energy which we call life.

When animal cells are rapidly killed by special chemicals and stained with certain dyes, bunches of minute coiled threads can be seen. They are called Golgi bodies, and not much is known about their use. They may be present in plant cells, but if so, the right way of making them visible has yet to be discovered. Plant cells would also seem to lack the speck-like centrosome, about which more will be said later.

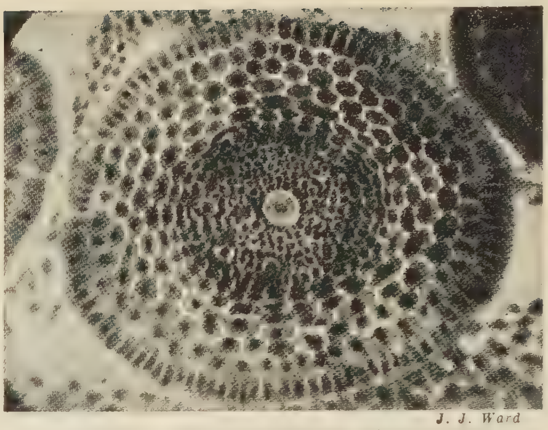
In the life processes of cells (*see* PLANT LIFE: RESPIRATION) the protoplasm used up is constantly replaced from the food carried in the blood of animals and the sap of plants. If the cells make more than they lose, they will obviously grow larger. It is the nucleus that seems to control these processes, very probably by enzyme actions (*see* ENZYMES), but as it does not grow as fast as the cytoplasm, the time soon comes when there is too much of this for it to control. Then, by a wonderful process called mitosis, the nucleus divides into two perfect copies of itself, then the cytoplasm is halved, making two cells out of one.

Before the nucleus is ready to divide, it contains a faint network which cannot be stained with dyes, and one or more globules of liquid (nucleolus, plural nucleoli), which can be deeply stained. When the time comes to divide, the stainable liquid, called chromatin, collects on the network, which breaks up into parts like short strings of tiny beads. The " strings " are chromosomes and the " beads " genes (*see* HEREDITY), which control all that the organism (plant or animal) inherits from its parents. The chromosomes are in pairs; human skin, muscle, nerve, and other cells have 24 pairs, and sweet-pea plants have seven pairs, in each nucleus.

Division of an animal cell starts with the centrosome splitting and the halves going round the nucleus to opposite points (poles). Round the part corresponding to the equator of the nucleus the chromosomes arrange themselves, pointing out into the cytoplasm, and each splits along its whole length to form two chromosomes. By this time the nucleus is no longer a ball, but shaped like two cones, their points at the poles and their bases joined at the equator. By some unknown force the divided chromosomes are dragged apart and move to opposite poles, where two new nuclei form. In a plant cell, not only does the cytoplasm divide across the cell, but also a cell wall is made separating the two cells.

At first, naturally, the new cells are smaller than the original one, but they too soon enlarge and divide, and it is this increase of cells which makes the living organism grow. Even when a human being or an animal has "stopped growing" the skin is constantly being renewed by cell division as the outer layers wear off, and the roots of hair and nails continue growing.

Masses of cells which eventually lose the power of division settle down and take on special work, altering their structure for the purpose. These different masses are called tissues. In muscle



J. J. Ward

A SINGLE CELL PRODUCES THOUSANDS

Here are seen thousands of cells grouped symmetrically round a central one, yet twelve hours before this photograph was taken there was only one cell. The original cell, in a cross-section of a barley root, first divided to form two; then these in their turn divided, and so on.

tissue the cells are long and elastic; in nerve tissue they develop long threads of sensitive cytoplasm; in bone they build up round themselves layers of hard material from lime and phosphates. Some kinds of plant cell are illustrated under the subject BOTANY. The bacteria and certain microscopic animals (*see* PROTOZOA) and plants (*see* ALGAE) have bodies that are not divided into cells, but as some of them are very complicated in structure many biologists prefer not to think of them as unicellular (i.e. one-celled).

Cells may die through injury, drying, poisoning, or general ageing. Some are still useful when dead—for instance, the outermost cells of the skin, which protect the living cells beneath, also wool, fur, hair, and nails (which are composed of dead cells except at the roots), the sap tubes in the wood of plants, and the protective bark.

Before the whole plant or animal dies it generally produces offspring. The reproductive cells for this purpose (*see* FLOWER) are of two kinds, very small male cells and much larger female or egg cells. They differ from every other cell of the organism, in that they have exactly half the usual number of chromosomes, because the cells which divided to form them did not allow their chromosomes to split, but sent a whole chromosome from each pair into each new nucleus. So when the male cell and the egg cell unite to form one cell, mixing the contents of their nuclei, this is the beginning of a new animal or plant and has the full number of chromosomes that each of its parents had in their cells. This new cell divides, forming two cells, which in turn divide and make four, and so on, until thousands of cells have formed the so-called embryo (pronounced em′-brēo), and this begins to form tissues and organs like its parents.

Cell (ELECTRICITY). *See* BATTERY.

Celluloid. In the middle of the 19th century a shortage of elephant tusks threatened the supply of billiard balls to such an extent that an American newspaper offered $10,000 (then worth more than £2,000) to anybody who could suggest a substitute for ivory.

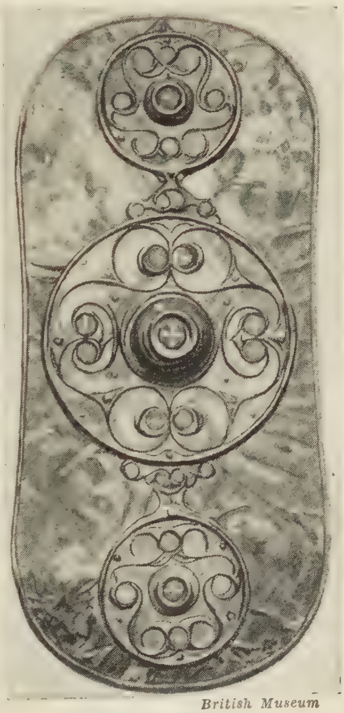
Among the competitors was a New York printer, John Wesley Hyatt, whose recipe was a mixture of wood, powder, shredded rags, glue, and nitric acid. Although his substitute did not win the prize, Hyatt continued to experiment, and some time later he found that by adding camphor to a mixture of nitro-cellulose and alcohol, a hard, horn-like material could be obtained. This material was called celluloid; it was the first plastic.

Although it is naturally of a clear, gelatine-like appearance, celluloid can quite easily be dyed various colours, and can, by certain special treatments, be made to imitate not only bone and ivory, but also amber, tortoise-shell, marble, and agate. It has thus been possible to use it for knife-handles, collars, accumulator cases, buttons, screws, piano keys, dental plates, photographic films, and spectacle frames.

Since the basis of celluloid is the highly inflammable nitro-cellulose, there was some danger in using it. If it touched an electric light for a few moments it caught fire, and fires have even been caused by the sun as it focused on celluloid articles in shop windows. Such risks, however, have been lessened by adding ammonium phosphate or tin chloride to the product during manufacture.

Celluloid softens in hot water, and is liable to shrink. It has now been generally replaced by new and harder plastics, and its chief use to-day is in photographic film.

Cellulose. One of the most useful substances in the world is cellulose, and fortunately it is very easily obtainable, because it is built up by plants. The process starts with the simplest of the carbohydrates, glucose $C_6H_{12}O_6$ (*see* CARBON). The glucose, dissolved in water, is transported through the stem of the plant and built up into other compounds, used by the plant as food reserves and structural materials. In plants like the sugar cane and sugar beet, the food reserve is sucrose, $C_{12}H_{22}O_{11}$—ordinary table sugar. This substance also exists early in the life of the carrot and the green pea; that is why these vegetables are sweet when they are young. It is more usual, however, for plants to go on adding to their reserve to build up starch, which has a formula something like $C_{600}H_{1000}O_{500}$. The human body can digest starch, and a great deal is consumed in foods like potatoes and bread. Beyond starch, with molecules ten times as long, plants arrive at cellulose. It is their main structural material, the long fibres providing the framework on which the leaves of the plant or tree are hung. This substance is not suitable for human food, but in other respects it is immensely valuable. Cotton and flax are almost pure cellulose. Cellulose is also the fibrous material of wood, straw, and sugar-cane stems, of coconuts (used for mats), of esparto grass (used in making paper), of hemp (for ropes), of jute (for sacking), and of many other materials.



British Museum

CELTIC SHIELD

The Celts put fine craftsmanship into their weapons and ornaments. This bronze shield, found in the Thames at Battersea, London, has had the enamelling restored.

Being so long, a cellulose molecule is naturally very strong. Rough treatment will, however, break up the molecule and weaken it—a fact of great importance in paper-making. The cellulose of which paper is made comes chiefly from wood pulp, and the weakest paper—that used for the daily newspapers—comes from pulp which has been mechanically chopped. This process breaks the cellulose fibres up into short lengths so that the paper made from them tears easily. It also goes yellow if exposed to the sun for a few days, because of impurities in the wood. The wood can be treated with strong alkali to remove the impurities and thus obtain a paper that remains white, but this treatment also weakens the cellulose fibres. If, therefore, a paper both strong and white is required, it is best to start with a purer source of cellulose, which will not need this treatment. (*See* PAPER.)

If cellulose is nitrated—that is, treated with a mixture of nitric and sulphuric acids—various cellulose nitrates are formed. These compounds, better known as nitro-celluloses, differ in their properties according to the temperature, the strength of the acids, and the length of time during which the cellulose is exposed. They are important to the making of explosives (gun-cotton), celluloid, paints, plastics, and leathercloth.

In the late 19th century, having discovered how to prepare fairly pure cellulose (for example, from bleached wood pulp), chemists began to think how it might be drawn out into a fibre which could be spun and woven. Viscose rayon, known technically as "regenerated" cellulose, was the result of these researches. It was discovered in 1892 by the British chemist C. F. Cross (1855–1935) and his associate E. J. Bevan, and is now produced in millions of pounds. Later came the valuable cellulose acetate rayon (*see* RAYON).

Pure wood-pulp cellulose is used also in the manufacture of "Cellophane," in cosmetics, in non-staining wallpaper adhesives, and even as a substitute for white of egg in meringues.

Celts (pron. kelts). The name *Keltoi* was given by the Greeks to a fierce people or peoples who from the late Bronze Age occupied central Europe north of the Alps, and in the early Iron Age appear to have used their great skill in working metals to conquer more primitive folk in what are now northern Italy, Spain, France, Belgium, Great Britain, and Ireland. They were most powerful during the last five centuries B.C. What held them together was language, not race, for

Cement and Concrete Association

EXCAVATOR DIGGING OUT CLAY FOR MAKING CEMENT

The first stage in the manufacture of cement is the quarrying of chalk or limestone, either of which may be used. The second raw material for cement-making is clay, which is usually dug by scraper-type excavator or by electric navvy from a pit, generally located some distance from the actual works. A scraper-type excavator is here seen at work in a pit. The electric navvy, which is a mechanical grab, loads the clay directly on to lorries which transport it to the works.

Celtic tribes seem to have consisted sometimes of Nordic types—tall, fair, and long-headed—and sometimes of stockier, broad-headed "Alpines" who neighboured and mixed with the darker Mediterranean peoples, and also with the dark, small Iberians, whom they pressed into Atlantic coastlands as far north as Wales and Ireland.

The Romans knew the Celts as the Gauls, who about 390 B.C. captured Rome itself (although the sacred geese saved the Capitol). Another Gallic horde invaded Greece and finally occupied a central part of Asia Minor, where, as Galatians, they were brought under Roman dominion by Pompey; a century later their Christian churches were visited and written to by St. Paul. Gaul itself was conquered by Caesar.

The Celts reached the British Isles in three main migrations—first the Goidels (perhaps in the Bronze Age), then the Brythons, and about 75 B.C. the Belgae, or Belgic Gauls, who were the first to oppose Caesar and the Roman invaders of A.D. 43, and were notable for blondness, bigness, boastfulness, bright clothing, chariot-fighting, and great hill-forts. Celtic speech developed differences; the Goidels used a *qu* or *k* sound, which descended into Scottish Gaelic, Erse (Irish Gaelic), and Manx, while the Brythons and Gauls used a *p* sound, which passed into Welsh, Cornish, and Breton (e.g. "son" is *mac* in Gaelic and *map* or *ap* in Welsh). Celtic art survives in metal-work remarkable for beautiful curvilinear decoration and the absence of the human figure. Celtic religion included complicated forms of nature-worship: the distribution of the priestly caste of Druids and the meaning of their name are still obscure. Before the Romans left Britain the Celtic Christian Church was well established, especially in Ireland.

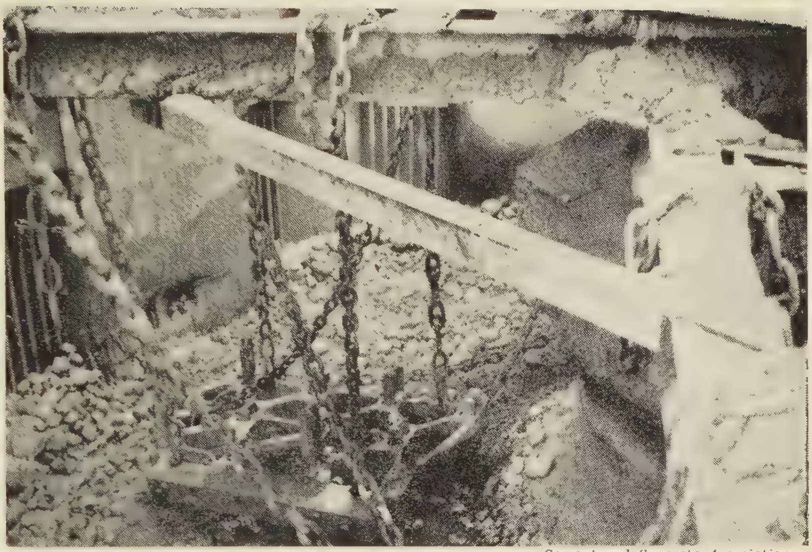
The subtle and imaginative Celt remains a very important element in the population of Britain. Few English families have failed to intermarry at some time with Celtic Scots, Welsh, or Irish, and it is probable that this admixture has done much to leaven the somewhat down-to-earth Saxon types with a sense of the mystery of things, and to widen their own poetic talent.

Cement. A broad definition of cement is: any substance that makes things stick together. Glue and rubber solution are well-known examples. Others are plaster-of-paris (used for surfacing interior walls) and the new synthetic resins, which are very strong, insoluble in water, and have many uses. However, the word cement usually means the Portland cement used in engineering and building construction, which will set under water, harden quickly, and attain great strength.

Until the 19th century the mortar used in brick-work or masonry was usually composed of a mixture of water, sand, and slaked lime made from limestone or chalk (*see* LIME). On exposure to the atmosphere this dries out and absorbs some carbonic acid from the air, and in the course of years attains a certain strength. Unfortunately it never gets really strong; it hardens very slowly, and will not harden in water, but, on the contrary, may be dissolved.

The first improvement was made by the Romans, those pioneers among engineers. They discovered that when certain little lumps of limestone found in clay beds were burnt they produced a lime which would set under water and harden rapidly.

Similar lumps were discovered in the London clay in the 18th century; and the lime from them is known as "hydraulic lime" or as "Roman" or "natural" cement. It sets more quickly than Portland cement, but it is not nearly so strong. Later the Romans found that by mixing volcanic ash, or *pozzuolana*, with lime they obtained a quick-hardening and strong hydraulic cement. This was the first attempt to make an artificial hydraulic cement. It is now known that volcanic ash and similar substances consist of silica in a very finely divided form known as "colloidal" silica. This unites with lime and water to form a new chemical combination. Lime will not combine with the silica of sand, but the lumps of Roman cement contain "colloidal" silica.



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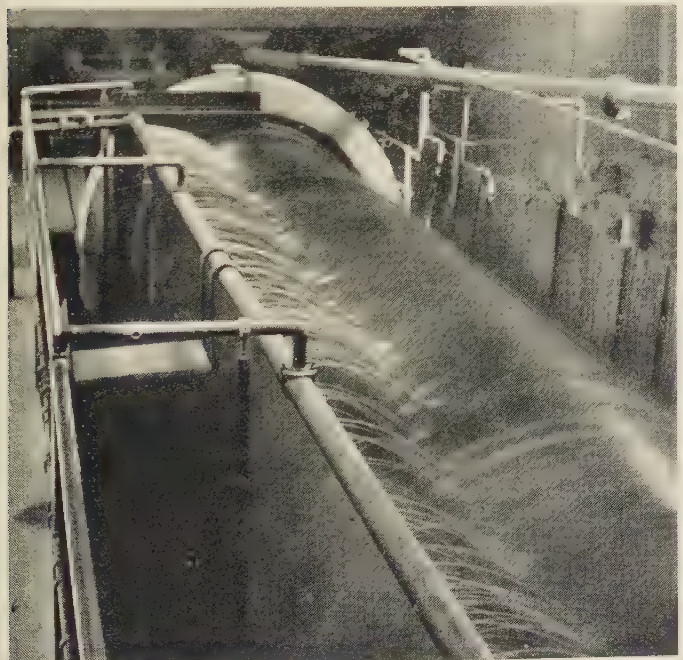
REVOLVING HARROW BREAKING UP CHALK

At the works the first process is to mix the chalk or crushed limestone with water to form the cement slurry (a pasty liquid). When chalk is used, the mixing is done in a large cement basin called a wash-mill, in the centre of which is a pivot around which revolve ponderous harrows, suspended from girders, smashing up the chalk.

John Smeaton discovered the importance of this experiment when building the Eddystone lighthouse. He required a strong, quick-hardening mortar that would not be dissolved by sea-spray or rain. After trying a mixture of lime and Italian *pozzuolana*, he found on the Welsh coast a limestone that contained clay. This produced a good hydraulic cement; and he used it to build the lighthouse, which lasted 120 years.

In 1824 a Leeds mason, Joseph Aspdin, mixed clay and finely ground chalk into a slurry (watery cement paste), dried it, and heated it to about 1,700° F., when the carbonic acid was driven out of the chalk, leaving lime. When this residue was ground, it made a hydraulic cement which had the colour of Portland stone. This was the origin of the name Portland cement, which is still in use. However, it was not a true Portland cement in the modern sense, but an artificial Roman cement. In 1845 I. C. White raised the temperature to about 2,500° F., when the silica and lime combined chemically to form new substances. When finely ground, these combine with water to form a strong cement—the modern Portland cement.



Cement and Concrete Association

CEMENT CLINKER GRINDING-MILL

Hundreds of tons of cement clinker are produced by the cement kilns every 24 hours, and this clinker has to be ground to powder. Considerable heat is generated during the process, so it becomes necessary to cool the mill either by a spray of water, as seen here, or by air.

Portland cement is manufactured from lime, silica, and a small amount of alumina. The lime is obtained from chalk or limestone, and the other substances are the main constituents of clay. Limestone is blasted from a quarry, broken, and ground to powder in a tube-mill—a revolving cylinder containing steel balls which roll round as grinders. Chalk is dug out by a steam shovel and dropped into a circular pit known as a wash-mill. Water is added and heavy revolving harrows break the mixture down into a slurry. The clay is turned into slurry in a similar

wash-mill. The chalk or limestone slurry is pumped to another wash-mill, and measured quantities of clay slurry are added to ensure that the chemical composition of the mixture is correct. Thorough mixing is done by revolving harrows. The slurry is then pumped through a series of revolving wire screens, which allow only very fine particles to pass, and then on into a rotary kiln. This is a long steel cylinder, 10 to 12 feet in diameter, lined with fire-proof bricks and revolving slowly on bearings. It slopes gently from one end to the other. The slurry is fed in at the high end; and a flame of powdered coal, gas, or oil is introduced at the low end to give a temperature of about 2,500° F. As the slurry moves slowly down the revolving kiln, the water is first evaporated; then the carbonic acid is driven off; and finally the mixture is changed into masses of small clinkers.

The clinker drops out in pea-sized pieces; is cooled by blasts of cold air; and is then taken to storage. Later it is conveyed to a tube-mill and ground to the required fineness. About two per cent. of gypsum—calcium sulphate—is added in the mill for the purpose of delaying the initial set. A great deal of heat is generated by the grinding, and the mill has to be kept cool by water sprays or by a current of air.

Alumina cement—a more recent invention—differs completely from Portland cement. It is also made from lime, silica, and alumina; but the proportion of alumina is ten or twelve times as much as in Portland cement. Hence bauxite—an aluminium ore—is used instead of clay. The heat in the kiln is raised to 2,900° F. At this temperature the materials melt and flow out of the kiln into moulds. When cold, these ingots are broken and ground to the necessary fineness. Electricity is generally used to heat the kilns, and so the product is often called "electric" cement. Alumina cement is much stronger than Portland cement, hardens very rapidly, and is not injured by sulphur waters. But it is very expensive.

Chemical and physical tests are carried out regularly during manufacture. The finished cement is tested for fineness by sifting it through a wire sieve with 29,000 openings per square inch. Not more than 10 per cent. must remain on the sieve. The tensile strength of the cement and the time it takes to set are also tested. (For the uses of cement, *see* CONCRETE.)

Census. Every government since the most ancient times has needed for various reasons to know the number of people in its territory. In the distant past "numbering the people" was carried out mainly to discover how many should be paying taxes and how many able-bodied men could be called upon to bear arms. No wonder census-taking was always unpopular, since no one wished to pay taxes or fight in the army if he could help it. King David, it is said in the Book of Samuel, was "tempted by Satan" to number the people, and as a result was sorely punished by Jehovah. In the Roman Empire, as appears in St. Luke, "all the world" was taxed, and everyone had to go back to his home-town to be counted. In Rome itself every citizen had to declare his and his wife's name and age and the number of his children and slaves before a magistrate (called a censor) every five years. William the Conqueror's Domesday Book (see article) was a census of property, land, and able-bodied men to give the new ruler of England a complete picture of the land he had conquered and its wealth and manpower.

It was more than 700 years after Domesday before a nation-wide census was again taken in England. In all that time the only records of population were the parish registers of births, marriages, and deaths. When it was suggested in 1753 that a national count from the parish registers should be carried out, a speaker in the House of Lords re-stated the age-old objections: "To what end should our number be known," he asked "except, that we are to be pressed into the fleet and the army? . . . And what purpose will it answer to know where the kingdom is crowded and where it is thin, except we are to be driven from place to place as graziers do their cattle?" But the next fifty years saw a complete change in outlook; to a better-educated public it seemed that the increasing population, the growth of new industries, and the movement of workers in

CENTAUR FIGHTING A LAPITH

A fabulous being of Greek mythology, the centaur had a horse's body and legs, but in place of the horse's head and neck were the head and upper trunk of a man. The centaurs lived in Thessaly and the Lapithae were their neighbours. The relief comes from a frieze in the Parthenon, Athens.

search of employment had to be recorded somehow if government was not to break down. In 1801 the first national census in Great Britain was taken, and, except in 1941, the people have been numbered every ten years since then.

At first local officials had to count the people, but from 1841 each householder has been responsible for filling up a census form, stating the number of persons usually living on his premises, their ages and employment, and various other items of information. The aim of the modern census is not to oppress the people by taxes or conscription, nor to examine individual records, but to bring local and national benefit through the proper planning of housing, education, and medical services, the placing of shopping centres, the provision of transport, etc. For these and many other purposes the authorities must know not only the total population but the number of people in various social groups and where they live. The Registrar-General's department collects the figures, groups them, tabulates them, and compares them, by means of intricate calculating-machines, and makes the answers available to government departments and others in need of statistical information.

COMMON BRITISH CENTIPEDE

The centipede is a creature with a distinct head, a pair of antennae, and a long, segmented body. Each segment (and the number may vary from 15 to more than 100) has two legs. The centipede in this picture belongs to the *Scolopendra* family.

Centaur (pron. sen′tor). One of a fabulous group of beings in classical mythology, the centaur had a horse's body and legs, but in place of the horse's head and neck was the head and upper trunk of a man. The centaurs lived in Thessaly, a famous centre of horse-breeding. It is said that in very early days a breed of wild horses roamed the Thessalian plains and that it took many generations to subdue their ferocity. Thus are explained the stories of the wildness of some centaurs and the mildness of others.

Chiron (or Cheiron) was the most celebrated of the centaurs, being noted for justice and wisdom. He taught the arts of music, healing, gymnastics, and prophecy to several Greek heroes. Refusing to take advantage of his immortality, he died of a wound from a poisoned arrow.

Near neighbours of the centaurs were the Lapithae, who formed a friendship with them. When the Lapithae king, Pirithous, was to marry the beautiful Hippodamia, the centaurs were invited to be guests. After the marriage some of the centaurs became wild, seized Hippodamia and some of her attendants, and made off for their own territory. Theseus, the great Greek hero, assembled an army and led them against the centaurs, who were defeated, made to give up their prisoners, and driven away into wild mountain country.

It is believed that the legend of the centaurs arose from a time when the Greeks had not yet learned the art of horse-riding, and were confronted with enemies who rode so well on horseback that each seemed to form part of his steed.

Centipedes (pron. sen′tipēdz). Only a few species of these many-legged creatures—the name is derived from the Latin *centum*, hundred; and *pedes*, feet—live in Great Britain, but they are found in great numbers in warm countries. Those in Britain are rather small, and they perform a useful service in eating ground-insects harmful to plants. The millipedes, which are related to them, are vegetarian and can do damage to crops, though they feed chiefly on decaying matter. They also have many legs, but not as many as the thousand that their name indicates. You can often find them lurking under stones in the garden; they quickly roll themselves into a coil when disturbed.

The larger centipedes live in tropical or semi-tropical countries, some of the biggest measuring 18 inches in length. These are usually ferocious creatures, living on insects, small animals, and birds, which they capture by means of their poisonous jaws. Their bite is fatal to many animals, and dangerous to man.

Centipedes and millipedes belong to the *Myriapoda*, or many-legged animals, which is one of the groups of the sub-kingdom *Arthropoda*, or jointed-legged creatures. Their bodies are long, and divided into segments, varying in number from 15 to over 100 according to the species. Each segment, except the last two, bears a pair of legs.

Central America. The so-called continent of North America is joined to that of South America by a strip of land nearly one thousand miles long and varying in width from about 30 miles to 300 miles. It stretches south-eastward from Mexico to Colombia, and on the east partly encloses the Gulf of Mexico and the Caribbean Sea. To the west is the Pacific Ocean.

This is now called Central America. It contains the republics of Guatemala, El Salvador, Nicaragua, Honduras, Costa Rica, and Panama, and the colony of British Honduras. Panama is cut through by the famous Panama Canal (see article), and 326 square miles of Canal Zone are recognized as United States territory, rented from Panama. The combined population of these countries is not much more than 12 million.

In the days of the Spanish conquest much of

CENTRAL AMERICA: THE ISTHMUS BETWEEN NORTH AND SOUTH AMERICA

From Alaska to the southernmost tip of Chile runs an almost continuous mountain chain, forming the backbone of North and South America. In both continents this backbone slopes down into broad stretches of level land, especially towards the east; but in Central America it rises from the Pacific and Atlantic Oceans with comparatively narrow coastal plains. By means of the Panama Canal man has cut the Americas apart. All the countries of Central America are independent republics, except for the colony of British Honduras.

the wealth of South America passed along this route; and corsairs established settlements on the Atlantic coast (the Spanish Main, as it was called) to plunder the richly-laden galleons. The same route was used by the "forty-niners" as a short cut to the gold rush of the 1840s in California. Another famous road, stone-paved for 50 miles, wound through tropical forests from Old Panama—sacked and burnt by the buccaneer Henry Morgan (see article) more than 300 years ago—to Puerto Bello. It was called the "gold road," and over it, on mule-back, were carried the gold, silver, and copper of Peru, and pearls from the islands in Panama Bay. Here Francis Drake took more booty from a treasure train than his band could carry, and was forced to bury part of it at the roadside, where it is reputed still to lie. And his bones, in a lead casket, are said to be sunk in the harbour of Puerto Bello, which he called "the mouth of the treasury of the world."

To-day the "gold road" is replaced by the Panama Canal; and the wealth of Central America is in coffee and bananas, which are shipped without let or hindrance in United States freighters to North American ports. Deep-sea fishing is now the mainstay of the islands.

A long range of mountains with many volcanic peaks runs from north to south, sloping precipitously to the magnificent sandy beaches of the Pacific shore, where the mean temperature is generally around 78 degrees, and more gradually to the steamy lowland Atlantic plains. Coffee is grown on the lava-fertilised mountain slopes, and bananas along the eastern shore—and, since the incidence of the banana disease, experimentally on the Pacific coast. This industry is operated mainly by American capital. Splendid hardwood forests clothe the lower mountain slopes, and in the foothills are large cattle ranches.

The resources of the region have not yet been fully developed, however, chiefly because of poor facilities for transport. The rivers are mostly torrential on the western side, or silted with mud on the eastern. Railways are usually no more than short systems connecting coffee or banana plantations with the coast. But to-day air travel, the Pan-American Highway and a connecting network of roads, and hydro-electric plants, have greatly hastened progress.

Though the various countries form a natural group, each has its characteristics. In Guatemala and Honduras archaeological research has un-

covered the most complete exhibits of Maya civilization in the world. Nicaragua, birthplace of the famous modern poet Rubén Dario, is noted for its classical colonial architecture. It is a land of vast lakes, enclosed from the sea by prehistoric volcanic disturbance, where salt-water fish have adapted themselves to inland conditions. In the lava are footprints of human beings and animals fleeing eruptions between 2,000 and 5,000 years ago. Costa Rica, often compared with Switzerland, is called " the land of eternal spring " and is famous for its beautifully-painted ox-carts and as being a country in which teachers outnumber soldiers—indeed, the army has been abolished. El Salvador, the smallest republic, with the largest output of coffee, has its Balsam Coast, where a special resin-bearing tree has provided the basis for medicines and cosmetics since before the days of the great explorer, Columbus.

The various groups of islands around the coasts are inhabited by distinctive peoples. The Cunas of the San Blas Islands are of pure stock, and do not admit of any intermarriage with whites or other Indians, nor will they allow strangers to settle on their islands ; Tobago, 12 miles from the Pacific entrance to the Panama Canal, is called " the island of flowers " and is a well-known resort. The Bay Islands, off the north coast of Honduras, are privately known as " the pirate islands " in honour of the first settlers ; but to-day the inhabitants are peaceful agriculturalists with a strong British tang and a standard of living above the average, with fewer people unable to read and write than any other region of the republic.

These countries have also much in common. All are nationalistic ; eager to develop more variety in their products and trade ; keenly interested in social welfare and education, and in developing modern trends in science and art without neglecting the culture of their fascinating past.

Central America was discovered by Columbus in 1502. Costa Rica was conquered by the Spaniards in 1513, and the rest of the country was overcome between 1522 and 1525 by Hernando Cortés after his conquest of Mexico. Great Britain colonised British Honduras in the 18th century, and exercised a protectorate over the Mosquito coast until 1860, when this territory was handed over to Nicaragua. The rest of Central America remained a Spanish dependency called Guatemala (with the exception of Panama, which belonged to New Granada) until the revolution of 1821, which established the present republics.

Centrifugal Force (pronounce centrif′-*u*gal). The dancer twirls on her toes ; her skirt flares out in a spinning disc. The racing car takes a bend at speed ; it drifts towards the outside edge of the track in what the driver calls a " controlled slide "—which is not at all the same as a skid.

Both of these things are caused by centrifugal force, that is, a force " that flies out from the centre." Even without stopping to think of it, everyone must have felt it. Whenever you are travelling in a bus and it turns a corner rather quickly, you feel a force pressing you against the person next to you, or (if the bus turns in the opposite direction) pulling you away from that person. Centrifugal force is the tendency of an object travelling along a curved path to pull away from what would be the centre if that curved path were a complete circle. If you tie a weight to a string and whirl it round, you can feel the weight trying to pull away from you. The faster you whirl the stone, the greater will be the outward pull, until the time comes when the string breaks and the stone goes off very rapidly indeed on a straight path. The sling used by David to fling the pebble that killed Goliath made use of centrifugal force.

One application in the " launderette " these days is found in the spin-dryer. Wet clothes are put in a perforated container which is revolved very rapidly. The clothes are held in place by the wall of the container, but the moisture in them is flung through the holes and the clothes are rapidly dried.

Centrifugal force can be applied to milk and cream, causing them to be separated by being whirled round, and the " centrifuge " is widely used in laboratories and industry. It was a method used in the early days of atomic energy experiments for separating atoms of very slightly differing weights. One of the earliest mechanical uses of the force was in the "governors" of steam engines, to keep the engine running at a given speed and prevent it from

CENTRIFUGAL FORCE IN OPERATION

Many familiar examples of centrifugal force are to be seen in everyday life. These chairs attached by chains to a revolving device are popular at fairs. As the apparatus goes round and round faster and faster, the passengers sitting in the chairs are whirled out farther and higher, until at last they go round and round almost horizontally.

"running away" if operating without a load. Two weights were mounted on levers that moved up and down as the weights separated. The faster the governor spun, the farther out swung the weights, lifting the lever and reducing the steam fed to the engine.

The force applied to a weight that is revolving rapidly becomes very great indeed, and high-speed engines have to be most carefully built to make sure that they do not destroy themselves. The compressor and turbine blades of a jet engine have to withstand many tons of centrifugal force, and experimental engines have often "burst" with disastrous results. Engineers testing jet motors usually stand behind thick concrete and steel protection barriers (*see* JET ENGINE).

One of the things that puzzles some people about centrifugal force is why the spin of the earth does not throw all living things away into space. The answer is that the earth, because of its great mass, holds its inhabitants on to its surface by gravitation. The earth's spin does, in fact, try to fling everything off the surface, but the centrifugal force is several hundred times smaller than the pull of gravity that keeps things in place.

Centrifugal force is worked out by considering the *mass* (m) of the object, its *velocity* (v), and the *radius* (r) of the circle in which it moves. The formula is: $F=\frac{mv^2}{r}$.

Cervantes Saavedra, MIGUEL DE (1547–1616) (Eng. pron. servan'tēz; Span. pron. thärvahn'tās). It has been said that to enter into the fullness of the great Spanish romance and satire, *Don Quixote*, the experience of the reader should be equal to that of the writer. "Children turn its leaves, young people read it, grown men understand it, old folk praise it." But few people have experienced so rich a life as Cervantes, the son of a poor and unsuccessful apothecary-surgeon, who became the greatest literary figure Spain has ever produced. The boy wrote poems while yet at school: in 1569, it is said because he was fleeing from justice, he went to seek his fortune in Italy. He became the servant of young Giulio Acquaviva, a future cardinal, but he soon turned his back on this quiet life and joined the Spanish army. In the battle of Lepanto (1571), when Spain and Italy destroyed the Turkish fleets, he insisted on taking part in the fighting, though suffering from fever, and received wounds in the chest and was left with a permanently disabled left hand.

But he continued his career as a soldier, and in 1576 he and his elder brother, *en route* for Spain to press for military promotion, were captured by Turkish galleys and carried off to Algiers, where they became the slaves of an Albanian pirate, Dali Mami. They were held to a high ransom, but the family could afford to pay only for Rodrigo, who returned home in 1577. So Miguel, as the younger brother, had to remain where he was, and spent his time working out elaborate but unsuccessful escape plans. In 1580 he was rescued by the Trinitarian monks. He spent the next six years in Madrid, writing plays and a novel. In 1587–88 he helped to provision the ill-fated Spanish Armada. After its defeat he moved to Seville, and managed to keep his post, but eventually he became involved in money troubles which led to several short terms of imprisonment and, indeed, dogged him until the end of his life.

It should be understood that although Cervantes was an industrious and prolific author of many poems, plays, and novels, as well as the now world-famous satire on exaggerated romances of chivalry, *Don Quixote* (Eng. pron. kwiks'ot; Span. pron. kēhō'tā), he had no great literary reputation until he was old and grey-haired, and in fact was not fully recognized in his lifetime. His writing never earned him riches; people laughed at the subtle humour of *Don Quixote*, the story of an aged and half-crazy knight-errant, but they did not realize for a very long time that it was a work of genius, the masterpiece of one who loved humanity while he gently mocked its failings. This affection is clearly shown in Cervantes' accurate drawing of character; his strange gallery of lords and ladies, eccentrics, servants, and humble country folk glows with vitality. Though the book is a satire, the prime aim of its author was gay entertainment.

MIGUEL DE CERVANTES
This famous Spanish novelist led a life of adventure, being in turn a soldier and a slave of Barbary pirates. The portrait, which belongs to the Academy of the Spanish Language, Madrid, is by Juan de Jauregui, Cervantes then being 53.

He might have been excused bitterness on the grounds of his failure to win special esteem as a writer during his lifetime, in spite of his unremitting and patient work; but mere bitterness is not a trait of the really mature mind.

In 1613, Cervantes must have felt his days were numbered, because he took the robe of the Franciscan Tertiaries, in pious preparation for death. He did die on April 23, 1616. (This is also the date of Shakespeare's death, but as England was then still using the Old Style calendar, Shakespeare had in fact died some days before —*see* CALENDAR.) Cervantes was buried in the grounds of a Trinitarian convent, his resting-place being left without a stone to mark it. If he ever made a will, it was never found.

The adjective "quixotic" has passed into the language to indicate behaviour which is noble and generous, but at the same time foolish.

Reproduced from a drawing by Gustave Doré

The STORY *of* DON QUIXOTE'S ADVENTURES

IN a certain village of the province of La Mancha in Spain (so Cervantes tells us), there lived a gentleman about 50 years of age, tall, thin, and gaunt-featured. His means were small, for he had sold many acres of land in order to buy the books he loved. Whenever he was at leisure (which was nearly all the year round) he gave himself up to the reading of those ancient volumes. They were mostly extravagant tales of impossibly noble and brave knights, but he regarded them all as absolutely genuine histories.

His brain became so filled with all that he read of enchantments, quarrels, battles, wounds, woo-ings, loves, agonies, and all sorts of nonsense, that finally with much reading and little sleep he lost his wits. Then he hit upon the strangest notion that ever a man of that time had, and that was to become a knight-errant himself, roaming the world over in armour and on horseback, in quest of adventures like the knights of old.

So he furbished up his great-grandfather's rusty armour, took lance and buckler, and adopted the high-sounding title of Don Quixote de la Mancha. His sorry-looking old nag he named Rosinante. Of course, a true knight must have a lady to be in love with, so he chose to honour a farmer's daughter (whom he scarcely knew) and called her by the romantic name of Dulcinea del Toboso.

Deciding that he needed a squire to attend him, he engaged a short, fat, farm labourer, named Sancho Panza, an honest, faithful clown of a fellow, whose wits were compounded of rustic ignorance and shrewd common sense. In reward for Sancho's services Don Quixote promised to make him governor of the first island or kingdom he should conquer. So the melancholy knight on his raw-boned steed, followed by his comical squire on an ass, set forth upon their adventures. They had not been long on the road before they came in sight of 30 or 40 windmills on a plain.

" Look yonder," said Don Quixote, " more than 30 monstrous giants present themselves ! I shall encounter and slay them, and with their spoils we will enrich ourselves, for it is fair war and a good service to sweep such evil fellows off the face of the earth."

" What giants ? What you see there are wind-mills," said Sancho Panza in amazement.

" It is clear," answered Don Quixote, " that thou art not experienced in the business of adventures. They are giants, and I will engage them in fierce and unequal combat." Then setting spurs to his steed, he cried out to the windmills : " Fly not, ye cowards and vile creatures, for it is but a single knight that attacks you ! "

Charging as fast as Rosinante could carry him, he fell full tilt upon the first mill. The wind swirled the sail round with such force that it shivered his lance, dragging after it horse and rider, who went rolling over and over.

DON QUIXOTE'S DISASTROUS TILT AT THE WINDMILL

Reproduced from a drawing by Gustave Doré

As Don Quixote and his servant Sancho Panza rode across a plain, they sighted some 30 or 40 windmills, which Don Quixote mistook for giants. Nothing that Sancho said could dissuade him from attacking the monsters. Clapping spurs to his steed, he ran his lance through a sail of the first mill, and, as the sail moved upwards, horse and rider were lifted off the ground and hurled to one side. Battered and bruised, the knight explained to the amazed Sancho Panza that some magician had turned the giants into windmills to thwart him.

Sancho Panza hastened to his master's assistance. "Bless me! Did I not warn you they were only windmills? No one could think otherwise unless he had something like windmills in his head."

"Friend Sancho," replied Don Quixote, ruefully, "I verily believe these giants have been turned into mills in order to rob me of the glory of vanquishing them; but such wicked arts will avail little against my good sword." Battered and bruised, but undismayed, the knight with some assistance remounted his lame old horse and rode away, still astonishingly confident that he would find chances for adventure.

Not long after this, he and Sancho Panza made their way to an inn. Don Quixote declared it was a castle, and, acting accordingly, got himself into many absurd situations. When he set out again he aroused the anger of the innkeeper by refusing to pay, for, he said, it was contrary to the laws of knight-errantry to pay for lodging or anything else.

"Thou art a blockhead and a pitiful innkeeper," he said, clapping spurs to Rosinante. But poor Sancho's bones were made to pay for his master's folly, for the people of the inn seized him and tossed him in a blanket until he could hardly stand.

Thus ran Don Quixote's adventures, as he went about righting wrongs that did not exist, or making them worse by his misguided interference—rescuing maidens from supposed danger or distress, killing imaginary giants, and challenging inoffensive wayfarers. At length some of his friends, disguising themselves, went in search of him. They made the foolish knight believe that he himself was under enchantment, put him into a cage, and brought him home. But after a time Don Quixote and his squire again set out on yet another round of quaint adventures. In the end he died at home and in his bed, with his niece and friends about him—quite sane again, and crying out against the histories of knight-errantry which had led him to commit such follies. Sancho was with his master to the last. "Forgive me, good friend," Quixote murmured, "for leading thee astray."

ISLAND GEM *of the* INDIAN OCEAN

> **Extent.**—North to south 270 miles; east to west 140 miles. Area, 25,332 square miles. Population, 8,750,000.
> **Chief Rivers.**—Mahaweli-ganga and Aruvi-aru.
> **Largest Cities.**—Colombo (the capital, 423,482 in 1953); Jaffna (77,218); Moratuwa (58,160); Kandy (57,359); Galle (55,874).
> **Chief Products.**—Tea, rubber, coconuts, rice, cacao, citronella, cotton, tobacco, plumbago.

Ceylon. One of the loveliest islands in the world, Ceylon has, from the beginnings of history, been visited by travellers who have returned to describe in most glowing terms its gentle grace and beauty. Ceylon has had more names given to it than any other island. The pilot of Alexander the Great's fleet was enchanted with it; Sindbad the Sailor called it "the island of rubies"; the Greek philosopher Aristotle relates how he had heard it named the "island covered with red lotus"; and the Moors called it the "island of delights." The name "Lanka," which occurs in ancient Hindu epics, is the one most favoured by the island's inhabitants, whose forefathers chose "Sinhala," from which comes the present name.

About half the size of England, Ceylon is a pear-shaped island lying off the south-east tip of India. It has two rainy seasons (monsoons) each year, and since it is partly mountainous and partly low-lying it has a most varied climate and scenery, with sunny beaches of yellow sands fringed with coconut palms, limpid lagoons, emerald green hills, tropical forests, and stretches of desert. It lies close to the equator, and its plains and forests are very hot and wet. But as the traveller goes into the hills the climate becomes cooler and drier and in several regions, and for many months in the year it is almost perfect.

The highest parts of the island rise to over 8,000 feet, and the best-known peaks are Pidurutalagala (8,294 ft.) and Adam's Peak (7,360 ft.). It has many rivers which flow across fertile plains. Plant and wild life flourish on the island. In the forests grow trees which yield satinwood, ebony, and teak, and orchids and other exotic plants thrive in the dense, hot jungle. The animals which roam the forests and plains include elephants, leopards, monkeys, water-buffalo, deer, and jackals; while crocodiles, lizards, and flying squirrels are commonest among the reptiles. More than 370 species of bird inhabit the island, ranging from flute-like songsters like the golden oriole and magpie robin to the shrill-voiced parakeet, besides the whistling teal and other wild duck, as well as myriads of waders which are found in the lakes and water-courses.

The island is 270 miles long and 140 miles wide, and the great variation in climate and soil over the 16 million acres of its land surface allows a diversity of crops to be cultivated. The growing of coconuts is centuries old, and is carried out all over the coast. Half of the annual crop of about 2,000 million nuts is exported in the form of copra, oil, desiccated coconut, and fresh nuts. Tea was introduced into Ceylon in 1837 and its cultivation on the hilly slopes has grown until it has now become the island's most important product. The cultivation of rubber is carried out widely in the wetter areas of the plains and it ranks next to tea in importance. These three main products account for 95 per cent. of Ceylon's exports. Other crops include cacao, citronella, cotton, and tobacco, besides rice and other food crops. Once noted for its production of spices such as cinnamon and pepper, Ceylon has reduced its production considerably because the world demand for these condiments has shrunk in the last hundred years, as other methods of food preservation have come in.

The gems of Ceylon have been famed for centuries. Sapphires, rubies, cats'-eyes and aquamarine are found in the south-west, and other semi-precious stones like topaz, garnet, zircon, and

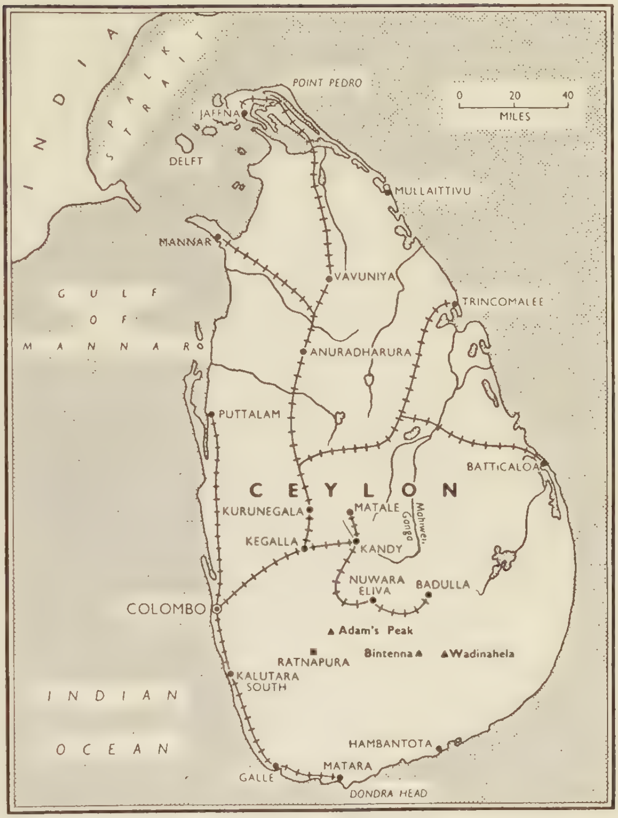
PAST AND PRESENT IN COLOURFUL CEYLON

Some 84 miles north of Kandy is the ruined city of Anuradhapura (left picture), which was the capital of Ceylon from 437 B.C. to A.D. 750, and is famed for its ancient monuments. In its vast size, 256 square miles, in the number and beauty of its temples, and in population, it compared with Babylon and Nineveh until it was sacked in A.D. 750. Part of the site has been reclaimed from the jungle, and a small modern town has been set up thereon.

Tea is one of Ceylon's most important exports, and in the ill stration immediately above Tamil coolies can be seen working on a tea plantation. In the other picture a fancifully-decked elephant bears the sacred tooth of Buddha through the streets of Kandy, preceded by musicians, dancers, and chiefs (above, right). Right: white sands, green palms and islets, and a warm blue ocean make the beaches of Ceylon unfo gettable. The craft are the outriggers used by fishermen.

amethyst abound. The annual value of gems mined is estimated to be between about £112,000 and £150,000. Ceylon is the world's principal source of plumbago (graphite) and there are also large deposits of kaolin (china clay) in the island.

With the means of life so easy to come by, the population has flourished. The original inhabitants were a people known as the Vedda, survivors of whom still live in rock shelters on the eastern side. Written history dates back to the first king, who was an Indian prince named Vijaya. He settled in the island some 500 years before Christ. The descendants of his subjects form the Sinhalese proper. Buddhism, the religion of most of the people, first came to Ceylon in the 3rd century B.C., when King Asoka of India sent his own son, Thera Mahinda, to carry the Message of Buddha to King Desanapiyatissa of Ceylon. The country then embraced Buddhism. The most famous of many Buddhist shrines there is the Temple of the Sacred Tooth at Kandy.



From the 1st century B.C. onwards Ceylon was invaded by south Indian (Tamil) princes, and this resulted in a fight for supremacy between the two peoples, Sinhalese and Tamil. In 1505 Portuguese adventurers arrived and conquered parts of the island. The Portuguese were driven out by the Dutch in 1640, and they in turn were ousted by the British in 1796. In 1815 the Sinhalese surrendered the whole of the island to the British, and it then became a British colony. In 1946, as the result of recommendations of a commission led by Lord Soulbury, Ceylon received a new constitution which gave it control over its internal affairs and opened the way to full membership of the British Commonwealth, which came into force on February 4, 1948. Much credit for the smoothness of this transition must go to the first premier, Don Stephen Senanayake (1884–1952), a great patriot and organizer, who during his régime set afoot immense measures to develop the industries of Ceylon and to improve the life of the people.

In 1947 Britain and Ceylon reached an agreement on mutual defence against outside aggression. This arrangement gave Ceylon the option of taking over defence installations (including the naval base at Trincomalee, with its magnificent harbour). The taking-over was completed in 1957.

Ceylon is governed by two houses of parliament, the senate and the house of representatives, both being elected by popular vote.

The mixture of Ceylon's population reflects its earlier history. The estimated total of 8,750,000 can be sub-divided into 6,000,000 Sinhalese, 1,000,000 Ceylon Tamils (that is, Tamils who have lived in Ceylon for over 800 years), 1,000,000 Indian Tamils (a floating body of immigrant labour, most of whom will return to India), 500,000 Ceylon Moors (descendants of Arab traders), and 250,000 others who include Europeans, Burghers (people of Dutch descent), Eurasians, and Malays. The Tamils are Hindus, and they are settled mostly in the north. There are about 500,000 Muslims and nearly 1,000,000 Christians.

The government of Stephen Bandaranaike, which was elected in 1956, passed an act making Sinhalese the only official language of the country. This was vigorously opposed by the Tamils, who threatened civil disobedience, but eventually, in 1957, it was agreed that Tamil should be the language of the northern and eastern provinces "as far as possible," without infringement of the act. Except for this, the various peoples in the island live together in harmony and a spirit of co-operation. Ceylon's position in the Indian Ocean makes its capital and largest city Colombo an ideal port of call for shipping between the West and East via the Suez Canal. The question of an official language for Ceylon is likely to be a disrupting feature of life for some time to come in this otherwise pleasant and happy island.

Cézanne, Paul (1839–1906). Whenever artists meet together nowadays, a ding-dong argument is likely to break out about Cézanne, the French painter. The English critic Clive Bell has always claimed him as one of Europe's greatest artists. Dr. Thomas Bodkin, on the other hand, while recognizing certain great qualities, calls him "neurotic, ill-educated," and says he was "crippled by want of adequate professional training." Of one portrait the sharp-tongued American artist Whistler said: "If a child of ten had drawn this on his slate, his mother,

"THE CARD PLAYERS," BY PAUL CÉZANNE

Cézanne is usually thought of as a landscape painter, and a characteristic example of his work in that field is reproduced with the article "France : Art" in Volume 3. The well-known picture reproduced above is now in the Louvre, Paris. Cézanne's highly individual art was strangely out of accord with the conventions of his day, often seeming laboriously distorted, yet it has had an incalculable influence on modern painting everywhere.

supposing her to have been a good mother, would have given him a hiding."

Though single-minded in his devotion to art, Cézanne was not one of those painters who live poorly in garrets. Born at Aix-en-Provence, he was the son of a successful hat manufacturer who later became a banker. Paul read for the law, but abandoned it at 22 for painting. His father gave him a comfortable allowance, and, when he died in 1866, left a useful fortune to the son. Paintings by Cézanne were refused by the Salon (the French near-equivalent of the British Royal Academy) in 1866. He showed his work in other exhibitions, but had no commercial success worth mentioning.

Slowly, laboriously, painfully, he worked out his own technique, with almost no professional help. He began by putting on thick blacks, whites, and browns. As time went on, his colours became gayer, and he came to paint in broad, clean, sweeping strokes. He had the idea that nature could be expressed by the cube, the cone, and the cylinder, and one has only to look at his tubular trees to see what he meant. In a sense he gives an "anatomy" of nature. The result is not anything that the normal eye sees ; but at its best it has an extraordinary beauty of its own.

Cézanne lived at various times in Paris, at Fontainebleau, at Anvers-sur-Oise, and in his native Provence. His way of life was quiet and hermit-like. Round about 1892 a powerful art dealer, Ambroise Vollard, began to see his merits, and by the end of the century his value was fully acknowledged in France. Soon after his death his work began to find many admirers in England too, and to influence the style of many English painters. His best-known work is in landscape, like "La Montagne Saint-Victoire" (National Gallery) and "Le Lac d'Annecy" (Courtauld Institute, London) ; and also in still life (*i.e.* pictures of common objects such as apples, bottles, and the like).

Chalk. Millions of years ago, vast numbers of tiny creatures called *foraminifera* lived and died in the sea. When they died their shells sank to the bottom and were compressed by the weight of water into the soft white limestone called chalk. A piece of chalk the size of a child's small building brick contains more than a million of these shells, but so numerous were the minute creatures that great chalk deposits are found in many parts of the world. Over the ages, earth disturbances have raised some of these beds and made them dry land. Towering cliffs of chalk border the south coast of England, and great beds underlie large areas of England and France.

Chemically, chalk is chiefly calcium carbonate (*see* CALCIUM). Large quantities are used in making Portland cement (*see* CEMENT). Much chalk is also roasted to lime, and it is an important constituent, as the name suggests, of the fertiliser "Nitro-chalk." Refined chalk is used in medicine, and other minor uses are as whiting, in making putty and the crayons used for drawing (pastels, as the artist calls them), and as a polishing powder.

Chamberlain. This was a surname that was prominent in British political life for over sixty years. It was borne by a father and his two sons, all of whom became distinguished ministers of the Crown, playing no small part in shaping the history of their country.

JOSEPH CHAMBERLAIN (1836–1914) was born in London, and made a fortune in Birmingham from the manufacture of screws. He retired early from business, becoming absorbed in municipal politics. He was mayor of Birmingham before he was 40, and gained a more than local reputation as an extreme radical who often expressed his strong republican views. It was as a radical Liberal member for Birmingham that he first entered Parliament in 1876. From 1885 until his death he represented West Birmingham. He soon held office in a Liberal government, but broke with his party in opposition to the policy of Home Rule for Ireland. Thereafter he was a Unionist, working with the Conservatives.

As secretary for the colonies, 1895–1903, he was the most conspicuous personality of a Conservative government, and was closely involved in the transactions that led to the Boer War of 1899–1902. That war convinced him of the need for closer economic ties between Great Britain and the countries of the British Empire. His plans to achieve those ends were not accepted by all Unionists, and he resigned office to organize a vigorous campaign in support of his policy. But

in 1906 he suffered a complete physical breakdown and thereafter took no active part in public life.

The cartoonists of his day made "Joe," with his monocle, and his orchid in his buttonhole, as familiar a figure as those of a later day made "Winston" and his cigar.

SIR AUSTEN CHAMBERLAIN (1863–1937), his elder son, was Unionist M.P. for East Worcestershire from 1892 to 1914, and thereafter for his father's old seat, West Birmingham. He held office for brief periods in the early 1900s, as postmaster-general and chancellor of the exchequer, and during the First World War as secretary for India. In 1918 he was a member of Lloyd George's war cabinet, and after the war he was again at the exchequer. In 1921 he was elected leader of the Unionist (Conservative) party, and as such was closely concerned in the 1922 settlement by which the Irish Free State was established. But he is most likely to be remembered for his work as foreign secretary, 1924–29, when, with Briand (of France) and Stresemann (of Germany), he drew up the Locarno Treaty of 1925, which seemed at the time a big step towards the maintenance of European peace. For this achievement he was made a Knight of the Garter and shared the Nobel peace prize.

NEVILLE CHAMBERLAIN (1869–1940), half-brother to Sir Austen, did not enter Parliament until he was nearly 50, yet he reached higher office than the other two ever achieved, for he became prime minister. Like his father, he first made his mark in local politics, and was twice lord mayor of Birmingham. From 1918 he was Unionist or Conservative M.P. for two Birmingham divisions—first Ladywood, then Edgbaston. He served successfully as postmaster-general, minister of health, and chancellor of the exchequer, before becoming prime minister in 1937, at the head of a so-called National, but predominantly Conservative, government.

He will long be remembered as chief sponsor of the pre-war policy of "appeasement," or conciliation, of the German and Italian dictators Hitler and Mussolini, a policy adopted in the hope of saving the world from the horrors of another great war. The signing, in September 1938, of the Munich agreement between Britain, France, Germany, and Italy, almost solely as the result of his exertions, and at a moment when war appeared imminent, brought his popularity to a high peak. But only 11 months later the outbreak of the Second World War proved the agreement worthless. With a heavy heart he set himself to lead Britain into war. But he was already stricken by a mortal disease, and in May 1940, when it was clear that he had lost the confidence of many colleagues, he resigned the premiership. Refusing all honours, he remained a member of the cabinet of Winston Churchill, but died within the year.

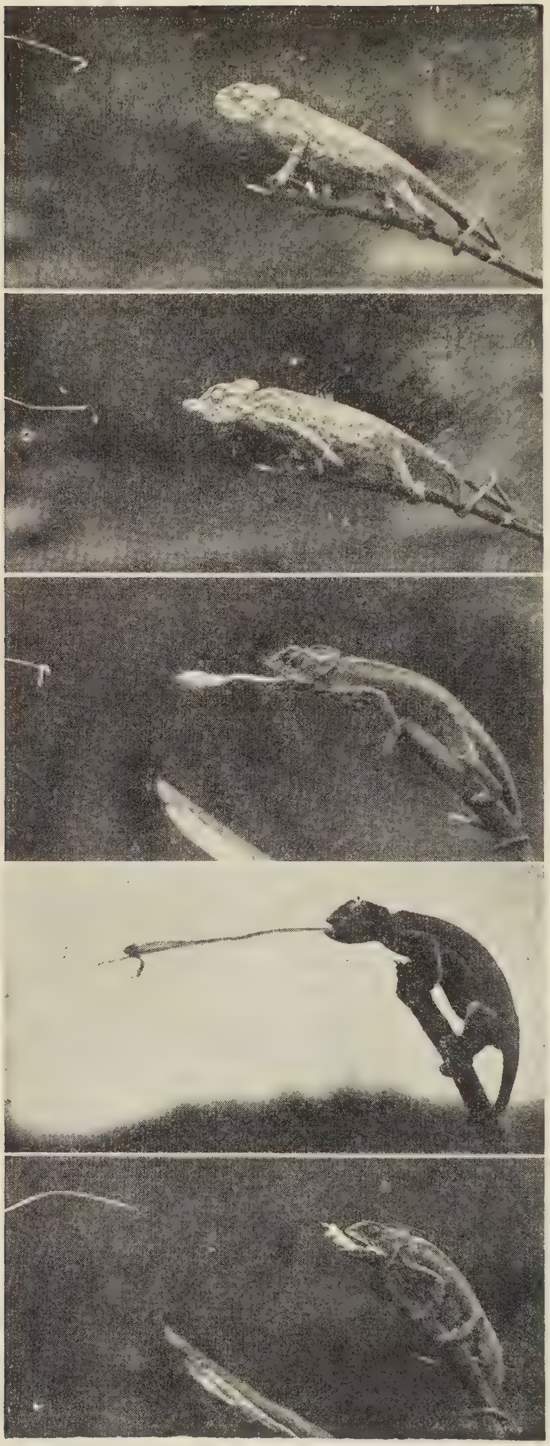
Chameleon (pron. kamē'leon). This lizard is an expert in the art of camouflage, for at one moment it may be a brilliant green, at the next grey-black, or chestnut and black, or covered with yellow spots. This is a form of protective coloration (see article), for the chameleon moves so slowly that if it did not have the power of taking on the colour of its surroundings, and so making itself very hard to pick out, it would become easy prey to hungry enemies such as the hornbill. The remarkable colour changes are accomplished by layers of cells beneath its transparent skin, containing yellow, black, and red colouring matter. These pigment cells are under the control of the nervous system, acting through the eyes and sense cells in the skin. By contracting and expanding they produce changes in coloration.

This ability to change colour is only one of the chameleon's strange features. The two big eyes move quite independently of each other, so that while one eye is studying a fly in front the other may be looking right back over the shoulder. The lids are fused over the big eyeballs and move with them, rather like gun turrets, only a tiny round

Vandyk

CHAMBERLAIN FAMILY : FATHER AND TWO SONS

This family gave three statesmen to British politics. Joseph Chamberlain (left), the father of Austen (centre) and Neville (right), was secretary for the colonies during the South African (Boer) War (1899–1902). He died in 1914. Sir Austen Chamberlain (d. 1937), the elder son, was foreign secretary from 1924 to 1929 and was made a Knight of the Garter in 1925. Neville Chamberlain became prime minister in 1937. He resigned in May 1940, dying the same year.



CHAMELEON CATCHING ITS MEAL

When hungry, the chameleon "lies low" with its colour adjusted to its surroundings. When an insect passes by, the chameleon shoots out its tongue, striking its prey with the skill of a marksman. The insect is glued to the tip of the sticky tongue, and is drawn back and swallowed. When not in use, the tongue is contracted into a ball. A motion-picture camera caught the series above, the whole process taking just about one-third of a second.

"window" being left open. The feet, too, are unusual, for each is divided into two parts, with three toes on one and two on the other, which give a most powerful grip, rather like a pair of tongs. Most chameleons have prehensile tails, with which they can cling, though these are usually kept coiled up like catherine wheels.

The chameleon also has a tongue unlike that of any other animal. It is very elastic, ending with a sticky blob, and it can be projected to catch flies and other insects farther away than the length of the chameleon's head and body.

There are about 80 kinds of chameleon. Most are found in Africa and Madagascar, but one kind lives in southern Europe and another in India. Most chameleons are between four and 12 inches long; the smallest, of just over an inch, and the largest, of just over two feet, are both found in Madagascar, off the African coast.

The so-called American chameleon (*Anolis carolinensis*) belongs to a quite distinct branch of the lizard family the *Iguanidae*.

Chamois (pron. sham'wah). "To leap like a chamois" is one of the truest of common similes, for indeed, when alarmed, this animal will flee to the most inaccessible places by a series of prodigious and dangerous-looking leaps, across chasms and up or down the faces of cliffs. It is a small, goat-like antelope, *Rupicapra rupicapra*, which lives in the mountains of central and southern Europe and western Asia, and is one of the swiftest and most agile of hoofed animals.

Chamois live in herds, sometimes of 20 or 30 beasts, and their senses are so acute that they are among the most difficult of animals to hunt. When feeding, they post a sentinel, which warns of the approach of danger by stamping and making a whistling noise. Chamois-hunting used to be a favourite pursuit in the Swiss Alps and in the Tirol, but the animal is now rare and is protected by law.

In summer the chamois ascends to the snow-line, coming down to the forests only in winter. Under its coat of coarse reddish-brown hair a thick under-fur grows in the winter-time. Its slender body is about three feet long, and two and a half feet high at the shoulders, with a short black tail. From the forehead rises almost vertically a pair of slender black horns six to eight inches long, which curve back at the top and become hook-shaped in an adult. Both sexes have these horns. The fine soft leather known as "shammy" was originally made from chamois-skin, though most of the skins now so called are really sheepskin.

Channel Islands. Within an hour of stepping into an aircraft at Southampton, after skimming over the Isle of Wight and flying high above the English Channel, the Channel Islands are in sight. First in view is wild, high Alderney, and the jagged brown and pink granite Casquet Rocks, on which many ships have perished. Farther to the south-west lie Guernsey, glass-houses shimmering in the sun, and the small islands of Sark and Herm, buffeted by the seas. Then come the great northern cliffs of Jersey, the southernmost island, and the landing at St. Helier, its capital and chief port.

Although politically they are included in the British Isles, the islands are geographically part of France and lie close to the Cherbourg peninsula.

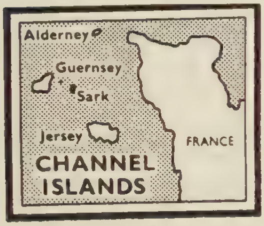
CHAMOIS CLIMBING A CRAG IN THE ALPS

One of the most fleet-footed, as well as sure-footed, of quadrupeds, the chamois can climb heights on which it would seem impossible to obtain a foothold. Here is a herd on a peak in one of their feeding-grounds on the Spietz Fluh in Canton Fribourg, Switzerland. In summer the animals ascend to the snowline, descending in winter to more sheltered regions. Chamois-hunting was once so popular in Switzerland and the Austrian Tirol that these animals were threatened with extermination. They are now fully protected by law in those countries.

They have much in common with the French Mediterranean in appearance and in the extreme mildness of climate. Weather conditions are ideal for the production of flowers, fruit, and vegetables, which are exported in thousands of tons annually. Long isolation throughout the centuries has made the people extremely thrifty and able to make use of the natural products of sea and soil. They excel in farming on the smallholding scale, in cattle-breeding, and in fishing.

In Jersey, the largest island (population 57,296), the three principal sources of revenue, apart from "the cultivation of tourists," are cattle, early potatoes, and tomatoes, all of which fetch very high prices. It has been said that "the treasure highest in a Jerseyman's estimation is his cow." These Jersey cows, always tethered, are the only breed permitted on the island; they are beautiful creatures with large soulful eyes and fawn and white coats. An abundant supply of seaweed, used as manure, contributes to the farmers' prosperity.

Guernsey began exporting flowers more than 100 years ago, but now tomatoes, grown intensively under glass, take first place. Between 1600 and 1900 much wool was spun and knitted, and the exports included warm garments known as jerseys and guernseys.



Every summer a carnival pageant called the "Battle of the Flowers" is held in either Jersey or Guernsey. The chief town of Guernsey is St. Peter Port, a centre for yachtsmen.

Alderney suffered greatly during the German occupation of the islands in the Second World War, and a large grant was made by the United Kingdom government for the rehabilitation of homes and farms neglected or damaged during this period.

The tiny island of Sark, picturesque in scenery and customs, is controlled by an hereditary "seigneur"—at present a lady, the Dame de Serk (an alternative form of the name). *Poulage*, or house tax, is still paid in live chickens. Leisurely horse-carriages are the only transport. But there is a more modern note in the new deep-water harbour, opened in 1949 by the Duke of Edinburgh.

The Channel Islands were part of the duchy of Normandy at the time of the Norman Conquest (1066). They remained loyal to King John when he lost his other French lands, and although in the following centuries they suffered many invasions by the French, they were never completely overrun. Coastal fortifications include Martello towers, built during the Napoleonic wars.

The islands are governed independently and separately by their own laws, which differ in many ways from those of England. They come from the old laws of Normandy, usage, custom, constitutions, and franchises granted by various English monarchs, and special Acts of Parliament. One ancient right is the *Clameur de Haro*, whereby

any inhabitant aggrieved by trespass on his land or injury to his buildings may fall on his knees and raise the cry: "Haro! Haro! à l'aide, mon Prince, on me fait tort." Thereupon the action complained of must stop until a court pronounces judgment.

Guernsey has its own parliament called the "States of Guernsey," and its area, or "bailiwick," covers the islands of Alderney, Sark, Herm, and Jéthou. Jersey is governed by its "States," which claims jurisdiction over the Ecréhous and Minquiers, neighbouring rocks inhabited in the summer by fishermen and yachtsmen. The principal officer in each "State" is the Lieutenant-Governor, who represents the Crown. The official language of the governments is traditionally French, but English is now optional. English currency is in use, but at the present time Jersey and Guernsey both issue their own copper coins, and Guernsey issues bank notes. Taxation is very low, compared with that of Great Britain.

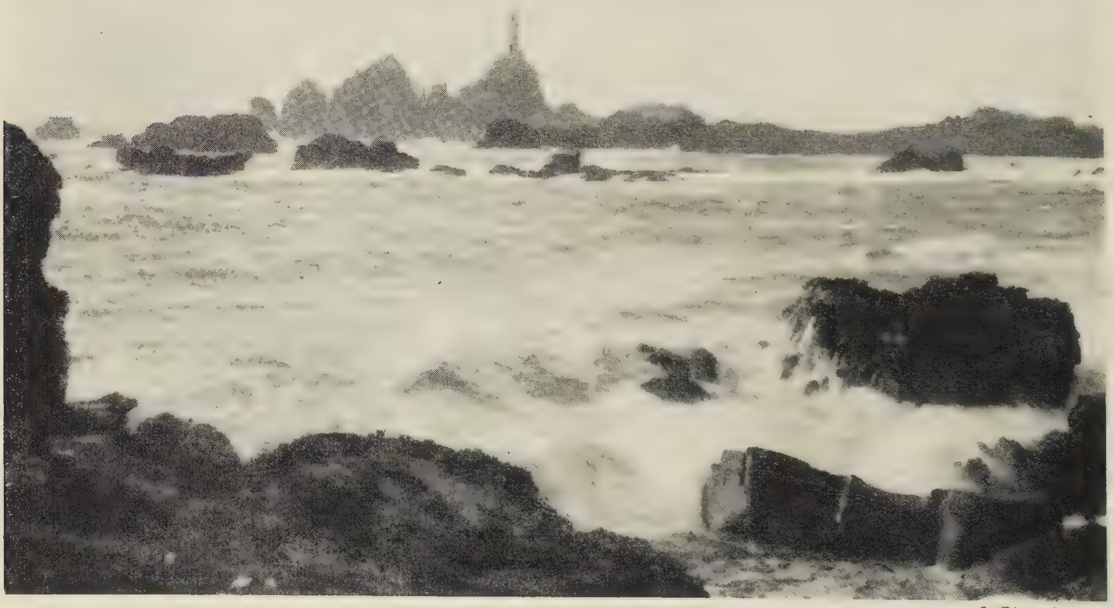
At various times the islands have provided a refuge for many celebrated religious or political leaders, among them the great French writer, Victor Hugo. To-day they are a popular holiday resort, and the combination of low taxation and good climate makes them attractive places in which to settle on retiring from work. The total population is 102,776 and the area 75 square miles.

Chaplin, CHARLES SPENCER (b. 1889). There is only one "Charlie." All over the world that single name, translated as Charlot or Carlitos, or in a score of other variations in all the chief languages of the world, means a little tramp in baggy trousers and big boots, with a springy cane and a jaunty walk, who has brought laughter, not unmixed with tears, to millions. Not many men become a legend in their own lifetime, but that has been the fortune of Charles Spencer Chaplin, born on April 16, 1889, and brought up in humble circumstances in Kennington, in south-east London.

His father and mother were both singers and entertainers, and Charlie himself went "on the boards" as a child in a dancing troupe called "The Eight Lancashire Lads" to help the family fortunes. Before he left school his father had died and his mother was an invalid. Charlie got a job as a page-boy in a play starring William Gillette and Irene Vanbrugh. He was fifteen. Soon he joined his brother Sydney in Fred Karno's comedy show, *The Mumming Birds.*

By the time he went to America in 1910 as part of Fred Karno's show, *A Night in an English Music Hall,* young Chaplin was getting to be a seasoned performer, well up in the tricks of slapstick comedy. The Karno show was popular and toured America for a long time. During this time strange things were happening at Los Angeles in California. A suburb called Hollywood was fast changing from a respectable retreat for retired clerks and invalids into a crazy place invaded by people making moving pictures. Already there were people called motion-picture producers on the look-out for new talent. Chaplin was approached by Mack Sennett (of "Keystone Cops" fame), but he was doubtful about films, and it was only when he was offered £25 a week (three times his salary from Karno) that he consented to go to Hollywood.

At first Sennett felt that he had made a bad bargain. But at Chaplin's appearance in his second



J. Dixon-Scott

CHANNEL ISLANDS : ROCK-BOUND COAST OF JERSEY

The Channel Islands are gems of natural beauty set amidst dangerous seas. Their coasts are rock-bound, and navigation near the islands is therefore difficult. This photograph shows what dangerous seas confront those who approach the group. The Corbière Lighthouse, on the island of Jersey, was built in 1875. It stands on a rock 90 feet above high-water mark, and the light, 135 feet above sea-level, is visible from 17 miles out at sea. The Channel Islands, once part of the old Dukedom of Normandy, are virtually self-governing communities.

film, released on February 7, 1914, he used the costume (shown in the picture) that all the world now knows. Within a few weeks he was writing and directing his own films. By 1915 a new star was blazing in the Hollywood heaven, and the long list of successes—still remembered when hundreds of more ambitious films are forgotten—was rolling out: *The Champ* (1915); *The Tramp* (1915); *Easy Street* (1916); *A Dog's Life* and *Shoulder Arms* (1918); *The Kid* (with Jackie Coogan) (1921); *The Pilgrim* (1922); *The Gold Rush* (1925); *The Circus* (1928); *City Lights* (1931); *Modern Times* (1936); *The Great Dictator* (1940); and after the Second World War that strange film *Monsieur Verdoux*, also *Limelight* (1952), and *A King in New York* (1957).

"CHARLIE" CHAPLIN IN HIS MOST FAMILIAR GUISE

The stock costume of the film Chaplin—bowler hat, baggy trousers, big boots, and cane—and his small property moustache became world-famous, and his tragi-comic air, no less than his amusing tricks of gait and gesture, endeared him to young and old. Here he is seen in *Modern Times*, in which his voice was heard for the first time.

As the years passed, the character of his comedy changed and developed. The slapstick, the breathless succession of gags still remained, but the situations grew up naturally around the human, romantic little figure that Chaplin had built up. Keen observation of the world about him made his films more and more a sort of comic sermon on the value of kindness, charity, good manners, and gay courage in the face of a harsh and uncertain world. He became more and more the champion of all the "little men" of the world against the powerful forces that seemed to be working against them. Thus from about 1936, Chaplin films became rarer and rarer and more and more concerned with social satire. *Modern Times* was a witty commentary on the plight of the ordinary man in the machine age, as seen by Chaplin. In *The Great Dictator* he satirised Hitler and Mussolini and extracted tremendous comedy out of them in the process. His genius is more suited to miming than to the sound film; and though in *The Great Dictator* he made a tolerably funny parody of a Hitler speech, this first full using of voice effects was not welcomed by some people.

Chaplin has probably more control over his films than any other actor living. He produces, he directs, he acts, he writes, he often composes the music. In *Monsieur Verdoux* and again in his *Limelight* he made the experiment of appearing in new types of parts such as would give him more scope for dramatic acting as well as retaining plenty of opportunity for sheer comedy.

Unlike most actors who made their name in Hollywood, Chaplin never became an American citizen or Americanised in his outlook. In 1952, having incurred the displeasure of authority on political grounds, he settled in Europe; and his film *A King in New York* contained much bitter satire on certain aspects of American life.

Charcoal. If wood is made to burn in insufficient air, it will smoulder, and turn into a substance called charcoal. The first of the man-made fuels, it burns with greater heat than an ordinary wood fire because it is porous, like a sponge, and each of the tiny holes becomes full of heat-forming gases.

Some charcoal is still made, in such places as the Forest of Dean, by the same method that charcoal-burners used thousands of years ago. A pit or "bury," 20 feet in diameter, is dug, and logs of wood a yard long are stood in tiers around a central chimney or flue, the thickest in the centre, and the thinnest outside. The logs are covered with shavings or brushwood, and cemented down with earth or turf to prevent air from getting in. A fire is lit in the central chimney and the burning carefully controlled. When smoke has ceased to escape, all the air vents are closed and the mass is left to cool down. By this method the heat of combustion of part of the wood serves to carbonise the rest.

This ancient method is very wasteful because

many valuable substances in the wood—wood tar, methyl alcohol, acetic acid, acetone, and various other gases—escape into the surrounding air. To-day the wood in the form of chippings or sawdust is burnt in closed retorts, heated by the gases which are given off. The process is much quicker, taking only 24 hours instead of several days, and the various by-products are recovered. In recent years, however, the wood distillation industry has lost a lot of ground, because most of these substances can now be made in other, easier ways.

Until about the 17th century charcoal was widely used for smelting iron and other ores, and as a domestic fuel. The growing shortage of wood then forced the iron industry to develop the use of coke for smelting, and caused domestic users to turn to coal. Ash and oak charcoal are still used for making certain high-grade steels.

Because charcoal is porous, it has the valuable ability to condense on its surface ("adsorb," the chemists call it) different gases and vapours. By its use, foul and harmful gases can be removed from the air, and it is therefore employed in gas-masks and to remove the dangerous gasoline vapour from "natural gas." Further present-day uses for charcoal are as an ingredient of gunpowder, as an industrial filter, and for taking the colour out of liquids such as sugar molasses.

Some two-thirds of the charcoal used in Britain is imported, mainly from Sweden, France, Belgium, and Germany. But some 9,000 tons are home-produced, two main centres being Ashdown Forest, Sussex, and Worksop, Nottinghamshire.

CHARLEMAGNE
The Emperor Charlemagne is here shown as painted by Albrecht Dürer (1471–1528). The French lilies and German eagle symbolise his rule over both Western and Eastern Franks.

Charlemagne (742–814). This is the usual form of the name of Charles the Great, pronounced in French sharl-mahn-y*e*, and in English sharhl′mān or shahrl′*e*mān. Charles's coronation as Holy Roman Emperor in 800 marked his attempt to reunite a large part of western Europe as it had been united under the Roman emperors 300 years before. It is also sometimes said to mark the end of the Dark Ages in Europe, and the beginning of the Middle Ages, for it ended centuries of warfare between the barbarian kingdoms which rose and fell in the ruined Roman provinces. Charles was a Frank; his father, Pepin the Short (son of Charles Martel, see article), was mayor or principal officer of state to Childeric II, the last king of the Merovingian dynasty.

In 752, with the Pope's approval, the vigorous Pepin deposed the ineffective Childeric, put him in a monastery, and made himself king of the Franks; the dynasty Pepin founded is called Carolingian, after his own son. Charles, a man of great stature, great gifts, and great ideas, inherited Pepin's respect for the Church. He used churchmen in civil government, and added to his own military talents a passion for order and learning, together with a clemency unusual at that period. This clemency broke down in dealing with the ferocious German tribes in the centre of Europe.

Charles may have been born at Aix-la-Chapelle, which he made his capital, and where he was buried. (For detail, *see* AACHEN.) His mother was Bertha, daughter of Charibert, Count of Laon. There was no fixed rule of succession among the Franks, and when Pepin died in 768 his kingdom was divided without question. Charles took Neustria, or northern France, and his younger brother Carloman took Austrasia, consisting roughly of Flanders and the Rhineland. Charles had at once to put down a rebellion in the vassal duchy of Aquitaine. In 771 Carloman died, and his young sons were passed over in favour of Charles; in this way the kingdom of Pepin was reunited.

In 772 began the wars which made Charles into Charlemagne. The Saxons burned churches and chased Christian missionaries. Charlemagne replied with fire and sword, reached the main seat of their religion, and then destroyed their mysterious Irminsul, or sacred tree. His nephews had sought refuge with the king of the Lombards in Italy, who took up their claim to rule the Austrasian Franks; Charlemagne crossed the Alps, and by the end of 774 had extinguished the Lombard Kingdom (this meant the northern half of Italy), annexed its territory, accepted the title of Patrician from Pope Adrian I, and received an oath of loyalty from the people of Rome.

Returning to Germany, he resumed his conquest of the Saxons, an operation which lasted on and off for thirty years. Thousands of heathen were massacred, deported, or compulsorily converted—a triumph military rather than religious. The Saxons when subdued had to be protected against even more savage peoples beyond; the Wiltzes on the Elbe were made tributory, the Danes discouraged from crossing the Eider, the Bohemians attacked around the head-waters of the Elbe. In 787 the Duke of Bavaria allied himself with the wild Avars to east of him, but was forced to submit before they could co-operate. By 796 the Avars had been driven back into Pannonia; part of their country was organized as a march or frontier province; this East March, or Oesterreich, is now Austria.

In 778, while Charlemagne was baptizing Saxons

at the point of the sword, a renegade Saracen invited him to attack the Caliph of Cordova in Spain. Charlemagne seized the opportunity; he reached the Ebro, but was not well supported by Muslim rebels, and so retired into France. On the way his rearguard was overwhelmed by Gascon hillmen in the wooded pass of Roncesvalles. Roland, commander of the Breton March, was among the leaders killed. When, down the centuries, legends of Charlemagne grew into a whole literature, this became the most famous story of all. In it the Gascons are turned into Saracens, the great horn of Roland breaks at his third desperate blast, and Charlemagne hears it from beyond the range of the Pyrenees.

To rid his Mediterranean coasts of pirates, Charlemagne sent a fleet and expelled them from Corsica, Sardinia, and the Balearic Islands. He also kept naval squadrons at Boulogne and other northern ports to beat off attacks already begun by Norsemen from Scandinavia. By 800 his power was at its height from the Elbe to the Atlantic, from Belgium to Catalonia, Rome, and what is now the northernmost part of Yugoslavia. On Christmas Day in that year, in St. Peter's Church at Rome, Pope Leo III crowned him emperor.

Charlemagne divided his empire into counties, in each of which a count represented him as civil, military, and judicial governor. He regulated military service, money, and weights and measures, introduced tithes (tenths), and fostered commerce and agriculture. He built churches, bridges, and schools, filled gaps in his own education, and summoned learned men from many countries. Among them was Alcuin of York, who became head of the palace school which the emperor's nobles as well as their sons were encouraged to attend. Foreign kings such as Egbert of England visited his court. The Caliph of Baghdad, Haroun-al-Raschid (the tyrant of the *Arabian Nights*), sent an embassy to Aix-la-Chapelle. At one time Charlemagne contemplated marriage with Irene, Empress of Byzantium. He died in 814, and without him his achievement could not last. Thirty years later his descendants divided western Europe in three, foreshadowing the shapes of France, Germany, and the debatable land between them which split up to become Flanders, Alsace-Lorraine, Burgundy, Switzerland, and Savoy. As emperor of both French and Germans, Charlemagne has haunted the dreams of conquerors on both sides of the Rhine ever since.

Charles, British Kings. Two Stuart kings of England and Scotland were named Charles. Charles I (1600–49) was instrumental in provoking the Puritan revolution, which although it often seemed to hinge on questions of religion was also social and economic. It united for a time those sects and interests which, after their joint victory had brought Charles to the scaffold in Whitehall, turned on each other in constant strife that in the end resulted in Cromwell's short-lived protectorate or dictatorship.

Charles was a weakly child with an impediment in his speech which he never quite outgrew. A second son, and so not at first expected to succeed to the throne, he had the strength of purpose to become an active follower of outdoor sports and an accomplished scholar; he was later to be the most cultured sovereign ever to wear the two crowns. It has been said that if he had acted with as much judgment as he read, and had shown as much discernment in life as in the arts, he might have figured among the greatest princes. "Charles was a scholar, a man of taste, a gentleman, and a Christian; he was everything but a king. The art of reigning was the only art of which he was ignorant." So wrote William Gilpin in 1798.

Irreproachable as a husband and father, and devoted to his brilliant elder brother Henry, Prince of Wales, who died before their father, Charles seems otherwise to have cared only for his father's favourite, George Villiers, Duke of Buckingham. James I died in 1625, and Charles succeeded to the throne. Three years later Buckingham was assassinated. Thereafter Charles preserved an aloofness even from his most devoted subjects; very conscious of his office, very sure that his responsibility was only to God, he expected unquestioning and unrewarded obedience. His lack of political imagination did not prevent his developing a capacity for deceiving his enemies and sacrificing his supporters, and he seemed unable to pursue a policy without leaving open a road in the opposite direction. Half a Scot and half a Dane, married in the year of his accession to Henrietta Maria, the daughter and sister of Roman Catholic and absolute kings of France, he ignored or misunderstood the spirit of his principal English opponents—Eliot, Pym, Hampden, Cromwell, all formidable statesmen, squires of old family with a stake in the country

ILL-FATED CHARLES I

That Britain's first King Charles was undeniably handsome is revealed in this copy of a painting by Van Dyck. He is dressed in the laced finery of the period, and is seen wearing the robe and insignia of the Order of the Garter.

who were supported by a few distinguished peers and by the increasingly important classes of lawyers, capitalist merchants and tradesmen, dissenting clergy, and the Bible-conscious craftsmen whose spiritual spokesman was John Bunyan.

In the first four years of his reign Charles dissolved four parliaments because in effect they challenged his assumption of divine right to rule. The chief practical issue was Charles's claim to collect taxes which the Commons had not authorised. It has often been incorrectly supposed that this claim had no justification. The controversy was full of dilemmas ; its legal aspect is even now obscure. What the king's "prerogative" gave him the right to do had never been closely examined, but the House of Commons, whose membership was predominantly Puritan, was determined to make him admit that under the Constitution he could obtain no supplies except through Parliament.

For eleven years Charles ruled without it. On his side were always the Anglican clergy, headed by Archbishop Laud, and most of the nobility, including finally Wentworth, who began as one of the king's critics and ended as Earl of Strafford and his devoted servant ; and with them a majority of country gentlemen. Numbers of these adherents were to die in Charles's service, no matter what private doubts they had about his supposed leanings towards Roman Catholicism, the disastrous early expeditions he sent against France and Spain, and the forced loans, martial law, and arbitrary imprisonments, by which he compelled obedience.

The attempt to force the Scottish Church to use English forms of worship raised Scotland in arms against Charles, and in 1640 he was compelled to summon the parliament later to be known as the Long Parliament. This assembly rapidly deprived Charles of his despotic powers, released his prisoners, and attainted Strafford, compelling the king to consent to his execution. Parliament then split on the proposed regulation of the English Church, and the party which supported the retention of bishops rallied round Charles; but he over-estimated his new influence, and his unsuccessful attempt to arrest the famous "Five Members" lost him more than he had gained and alienated the City of London.

Civil war broke out in 1642. Both sides consisted mostly of amateur soldiers, and the first and second campaigns were full of bungling and indecisive action, much complicated by the geographical distribution of the combatants. The third campaign, in 1644, brought the Scots in on the Parliamentary side, and ended with their joint victory of Marston Moor (July 2). The fourth campaign was decided by the Parliamentary victory at Naseby (June 14, 1645). In the fifth, isolated Royalist strongholds were taken. The Presbyterian element in Parliament then quarrelled with the Army and for a time proposed to restore Charles on its own terms ; but the Army kidnapped him. While a prisoner, he intrigued with Presbyterians, Scots, and Royalists so successfully as to provoke a second Civil War in 1648. Again victorious, Cromwell became persuaded that Charles must be called to account. Parliament was purged by the army, and its remnant, the "Rump," undertook the trial of the king—perhaps the most controversial action in British history. With no sanctions but those of the sword and of the determination of a small number of high-minded, capable, and exasperated Englishmen, Charles was tried for treason, found guilty, and beheaded on January 30, 1649.

He met his fate with magnificent courage and dignity, inspiring a gifted enemy, the Puritan poet Marvell, to write :

> He nothing common did, or mean,
> Upon that memorable scene,
> But bowed his comely head
> Down, as upon a bed.

That blow of the axe still resounds in English hearts, and clouds the processes of English thought. From 1662 to 1859 the execution was commemorated in the calendar of the Prayer Book, and by some he is still regarded as a "blessed martyr," who would no doubt be a saint if the Anglican Church had the machinery to canonise him. The statue of Charles at Charing Cross is the focus of an annual pilgrimage and a special service.

National Portrait Gallery

KING CHARLES II

This portrait of Charles II by Mary Beale (1632–97) shows him wearing the fashionable full-bottomed wig. He is depicted not as the "Merry Monarch" of tradition, but as the grave and cynical Stuart, who ruled much more successfully than his father or his brother.

Charles II (1630–85) was the second son of Charles I. When his father was beheaded in 1649 the younger Charles was 18 years old and safe in France. The Royalists of Scotland at once summoned him to be their king, and in 1650 he landed in that country, was crowned at Scone, and with 10,000 Scots marched into England. This army was routed by Cromwell at the Battle of Worcester (September 3, 1651).

For six weeks Charles wandered about, a fugitive with a price of £1,000 set on his head. More than 40 persons shared his secret ; no one betrayed him, and after numerous adventures he escaped once more to France. After 10 years more of exile Charles II was recalled in 1660 to the throne.

Selfish, clever, and competent, with much less principle than his father, he captivated almost everyone with his easy good nature and charm of manner. One of his courtiers, the talented Earl of Rochester, wrote an imaginary epitaph for him that ran :

> Here lies our sovereign lord the king,
> Whose promise none relies on ;
> He never said a foolish thing,
> Nor ever did a wise one.

The king's reply was that his acts were those of his ministers, but his words were his own. A good talker, well read, and a patron of the arts, he made notable additions to the already splendid royal picture collection. He was also interested in science, and founded the Royal Society in 1662, with himself as first president.

Charles found the nation divided, and he set to work to unite it and make his position secure—determined, as he put it, never to set forth on his wanderings again. If he was unscrupulous in the means he employed, the bulk of those with whom he had to deal were no better. His toleration for Roman Catholics and nonconformists was admirable, and far ahead of his time, but he could not prevail against the natural suspicion of the British people towards "Popery" in any form. Parliament also grew suspicious of his attempts to create a large standing army. The classic case of royal secret diplomacy in English history is the Treaty of Dover, 1670, by which Charles obtained an alliance and a large income from Louis XIV and promised to become—or some time to reveal that he had already become—a Roman Catholic.

Charles's greatest service to his country was, however, his support of colonial development. Already under Charles I and Cromwell permanent settlements had been made in several West Indies islands. Charles II turned his attention to the colonisation of the mainland. The Carolinas were founded in 1663, and New Jersey in 1665. The New Netherlands, captured from the Dutch in 1664, were confirmed as an English possession in 1674 and renamed New York. Pennsylvania was founded in 1681. In India, Bombay was obtained from Portugal as the dowry of Catherine of Braganza, daughter of John, King of Portugal, whom Charles married in 1661 ; and in West Africa Charles II supported English traders who founded Cape Coast Castle, on the Gold Coast, in 1661. The protection of these overseas possessions necessitated a strong navy, and the man who best served the king in developing it was Samuel Pepys (see article).

Charles II's policy of friendship with France brought him into conflict with his chief counsellor, the Earl of Clarendon (earlier Edward Hyde), and Charles allowed the Cavalier Parliament to accuse Clarendon of misbehaviour whilst in office and to force him into exile. Charles followed a crooked course, bribing and flattering Parliament and yielding whenever opposition proved too strong ; but towards the end of his reign he attained a great measure of political success. He prevented Parliament from excluding his Roman Catholic brother James from the succession to the throne, and his French pension enabled him to rule the country during his last four years without calling another Parliament. He died on February 6, 1685, and on his deathbed announced his membership of the Roman Catholic Church, to which he had belonged in secret for most of his life.

Charles had no family by his queen. Among more than a dozen illegitimate children were the sons whom he made dukes respectively of Monmouth (Monmouth laid claim to the throne and led an unsuccessful rising against James II), Grafton, Richmond, Cleveland, and St. Albans (the mother of the last-named was the actress Nell Gwynn).

During Charles's reign occurred the Great Plague (1665), the Great Fire of London (1666), and two wars (1665–67 and 1672–74) against the Dutch, England's rivals for overseas trade ; but Parliament finally compelled Charles to make peace with this Protestant power, whose Stadtholder or ruler was William, Prince of Orange (son of the William who married Charles's sister Mary), later to become William III.

Charles, KINGS OF FRANCE. Charlemagne (see article) was the first Charles to rule over what is now France, though his reign belongs rather to the history of western Europe as a whole than to that of any one of the separate kingdoms. Charlemagne's grandson, Charles the Bald, who received the western part of his father's empire, is usually called Charles II of France (823–877) ; sometimes Charlemagne is left out, Charles the Bald becomes Charles I, and his nephew the emperor Charles the Fat (832–888) is included as Charles II. Charles the Bald's grandson Charles III, the Simple (879–929), and Charles IV, the Fair (1294–1328), last of the elder line of Capet, may be passed with bare mention.

CHARLES V, the Wise (1337–80) was virtually king from 1356, when his father King John was taken prisoner by the Black Prince at Poitiers. He was ruling at the beginning of the second period of the Hundred Years' War ; his general, Bertrand du Guesclin, eventually drove the English almost completely out of France. Charles at one time lost control of Paris, and had also to face the terrible peasant revolt known as the Jacquerie (1358) ; he waged a successful war against Navarre (then a small kingdom between France and Spain), failed to unite Brittany with France, but organized an efficient navy.

CHARLES VI, the Well-beloved (1368–1422), was an unfortunate king. His minority was disturbed by the quarrels of his uncles, the brothers of Charles V. When he grew up he almost immediately became mad, with only rare intervals of sanity. Struggles for control of government between the factions of the king's brother, the Duke of Orleans, and his uncle, the Duke of Burgundy, were marked by the assassination of Orleans and later by that of Burgundy ; intermittent civil war raged between their parties.

In the midst of this disorder Henry V of England renewed the Hundred Years' War in 1415, won his great victory at Agincourt, and shortly afterwards married Charles's daughter Catherine, and secured the reversion of the French crown. The death of both Charles and Henry in 1422 found the north of France in English hands. Henry VI of England was crowned King of France, while his uncle the Dauphin (later Charles VII) retained a feeble hold in the centre of the country.


CHARLES VII AND CHARLES IX, KINGS OF FRANCE

France was ruled by ten kings of the name of Charles. Charles VII (left-hand picture), crowned in 1429, owed his throne to the victories of Joan of Arc. This portrait by Jean Fouquet is in the Louvre, Paris. On the right is a painting, also in the Louvre, of Charles IX, who was induced to agree to the wholesale massacre of the Huguenots (French Protestants) in 1572

Charles VII (1403–61) was not acknowledged as king until 1429; the courage and faith of Joan of Arc (see article), enabled her then to see him crowned at Rheims. The greatest blot on his fame is that he made no effort to save Joan's life. Her influence, however, proved decisive in the end, for before Charles's death the English had lost all their French conquests except Calais, and the Hundred Years' War was finished.

Charles VIII (1470–98) proved to be but a feeble successor to his father Louis XI, the cunning son of Charles VII, who outwitted Charles the Rash of Burgundy and immensely strengthened the French monarchy. As a boy king, Charles VIII left the government to his capable sister, Anne of Beaujeu. Her influence obtained his marriage to Anne, heiress of Brittany, which at last secured to France this hitherto independent duchy. Charles VIII, however, was an unpractical dreamer, who planned first the conquest of Italy and then a mighty expedition against the Turks at Constantinople. His expedition into Italy in 1494 promised success; the Florentines drove out their rulers, the Medici, and welcomed Charles to their city. Both Rome and Naples fell into his hands, but his enemies formed a combination against him, and he was glad to escape to France in 1495. He died in 1498 while preparing another war against Italy.

Charles IX (1550–74), last but one of the Valois line of French kings, was ten years old when he came to the throne during the religious wars between the Catholics and the Huguenots (French Protestants). The crimes committed in his name were partly those of his ambitious mother, Catherine de' Medici (*see* Medici). To her also must be attributed the chief blame for the Massacre of St. Bartholomew in 1572, when thousands of Protestants were killed in Paris and the French provinces. The delicate young king was haunted by his share of responsibility for these atrocities, and died two years later.

Charles X (1757–1836), last Bourbon king of France, succeeded his brother Louis XVIII in 1824. Like Louis, he had "learnt nothing and forgotten nothing" during and after the French Revolution. His ambition was to restore the clergy to their former importance, and to bring into being a powerful and privileged aristocracy. When he tried to suspend the constitution and muzzle the press, Paris revolted. (July 1830). Charles fled to England and was succeeded by his distant cousin Louis Philippe, Duke of Orleans, last king of France—or, as he was more exactly entitled, king of the French.

Charles Martel (c. 690–741). By the year 732, exactly 100 years after Mahomet's death, the Saracen armies had swept west from Arabia across northern Africa, had conquered Spain, and were rolling northward through France. The fate of Europe hung in the balance; the green banner of the prophet stood before Tours, within striking distance of Paris. Eudes, Duke of Aquitaine, had been defeated by them; he appealed for help to Charles, duke of the Austrasian Franks and mayor of the palace to the last incompetent kings of the Frankish Merovingian dynasty. Charles led a Frankish army from the north-east, and met the invaders between Poitiers and Tours. Abderrahman, the Muslim commander, was killed, and the Saracens were routed and driven back to the southernmost parts of France. Europe was saved for Christianity, and Charles had earned his nickname of Martel (the Hammer).

From 733 to 739 Charles (who had already campaigned against the Saxons in what is now Westphalia, and the Frisians in what is now the Netherlands) defeated the Burgundians and conquered the Rhône valley, capturing Arles and Marseilles. His successes paved the way to the throne for his son, Pepin the Short, who succeeded him as mayor of the palace and made himself king in 751 or 752. Their activities laid the foundation for the future power of Pepin's gifted son, Charlemagne (see article).

Chatham, William Pitt, Earl of (1708–78). While the elder Pitt was still at Eton his grandfather remarked that he was "a hopefull lad, and doubt not that he will answer all his friends' expectations." He fulfilled this prophecy by becoming one of the foremost statesmen in British history, and certainly the greatest of his day.

William Pitt entered Parliament in 1735, and quickly made his mark as an orator. He opposed the government on a number of unpopular measures, and soon had a great following in the country, particularly among the City merchants, but earned the dislike of King George II. Not until 1746 was Pitt appointed to an office of any importance—that of paymaster-general to the forces, in which he increased his prestige by refusing, contrary to custom, to accept any money beyond his legal salary.

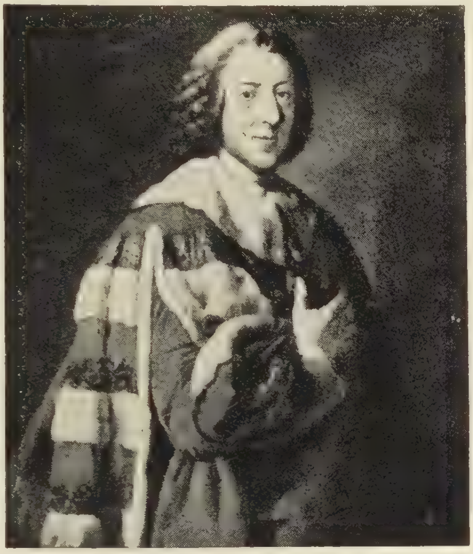
Colonial rivalry between Britain and France in North America, India, and elsewhere was one of the causes of the outbreak, in 1756, of the Seven

Years' War, in which Britain, allied with Prussia and Hanover, was opposed by France, Austria, Russia, Sweden, Saxony, and Spain. The war began disastrously, and this led to the downfall of the Duke of Newcastle's ministry, on which the King was obliged to call in Pitt. In 1757, as secretary of state, he undertook supreme direction of foreign affairs. "I know that I can save this country and that no one else can," he had told the Duke of Devonshire. To the king he said: "Sire, give me your confidence and I will deserve it." "Deserve my confidence," replied the king, "and you shall have it." The promise was well kept on both sides. Pitt showed himself equally adept in administration and strategy and in his choice of commanders (General Wolfe is a notable example). By 1759 the writer Horace Walpole was saying: "We are forced to ask every morning what victory there has been for fear of missing one." Wolfe's victory at Quebec finally destroyed French power in Canada; Clive's at Plassey made the British masters of Bengal; the French navy was almost entirely destroyed in actions at Lagos and Quiberon Bay.

But in 1760 the old king died, and his grandson, George III, who had no confidence in Pitt, favoured the party anxious to make peace. In 1761 Pitt resigned, and for most of the rest of his life remained in opposition. In 1766 he was created Earl of Chatham and asked to form a government of all parties; but the peerage lost him his power over the Commons and lessened for a time his popularity among those who had revered him as "the Great Commoner." He failed to repeat his former triumphs, and prolonged ill-health caused him to resign. In opposition, when well enough to attend the House, he constantly urged more sympathetic treatment of the American colonies in their resistance to taxation. In home affairs he strongly supported the liberty of the subject in the case of the famous John Wilkes, M.P. and journalist.

In 1778 the sick old man, hardly able to stand, dragged himself to the House of Lords to oppose a motion to recognize American independence. After a few broken sentences he fell back fainting, and was carried out. He died within a few weeks, and was buried in Westminster Abbey.

Lord Chatham had his faults. He was proud and ostentatious, difficult to work with, sometimes inconsistent, possibly too little concerned with the cost and misery of war. But though the merits of particular actions are still debatable, he remains beyond all question a statesman of genius and a maker of history, as was his second son, William Pitt the Younger (see article), who followed on in the next generation.



1st EARL OF CHATHAM

Here is Richard Brompton's (d. 1782) portrait, in the National Portrait Gallery, London, of William Pitt, Earl of Chatham, a man of integrity in a corrupt age. He won Canada for Britain.

Chatterton, Thomas (1752–70). This tragic figure in English literature, known for all time as, in Wordsworth's words, "the marvellous boy," was born in Bristol and educated at the bluecoat school called Colston's Hospital. His uncle was sexton of the famous church of St. Mary Redcliffe, and Thomas would spend many hours examining the old manuscripts—parish registers, bills for repairs, letters, and so on—which had lain in boxes in the muniment room there.

At the age of 12 he composed a poem which he copied on to some old parchment—using the old-fashioned spelling and grammar he had learnt from the manuscripts—and showed it to his schoolmaster. The latter was deceived into believing that the poem, called "Elinoure and Juga," was a genuine ancient document, and, more as a joke than for any other reason, the boy forged more "ancient" papers which he said he had found in St. Mary Redcliffe church. One was a supposed description of the opening of Bristol bridge in the year 1248; others formed a set of poems which were supposed to be the work of a 15th-century monk, T. Rowley. The Rowley poems were destined to become famous in literary history. Many Bristol people and some well-known literary men were deceived by the boy's handiwork, which indeed showed much poetic promise, but Horace Walpole, to whom Chatterton sent some "manuscripts," soon discovered that they were forgeries.

Those who had been deceived by Chatterton turned against him, and he was involved in bitter quarrels and disputes. At last he left the attorney (solicitor) to whom he had been apprenticed, and came to London in 1770. He lodged in great poverty in a garret in Brooke Street, Holborn, and wrote more poems, including his best work, "The Excelente Balade of Charitie," and political articles; but these brought him less than enough to live on. He declined to take advantage of the patronage of wealthy Londoners, and was too proud to ask his friends or family for help—indeed, he wrote home cheerful letters describing his "successes." Within a few months, however, he was starving, and when he was only 17 years and 9 months old he poisoned himself with arsenic after tearing up all his remaining writings. Shelley, Coleridge, and Keats, as well as Wordsworth, wrote verse tributes to his memory; his life has provided material for a play and a novel, and his death was the subject of a famous painting by Henry Wallis which is in the Tate Gallery.

The FATHER *of* ENGLISH POETRY

Chaucer, Geoffrey (*c.* 1340–1400). "Chaucer's England" is the heading that Dr. G. M. Trevelyan gives to the opening chapters of his famous book *English Social History.* Not the England of the Black Death, the Peasants' Rising, the Hundred Years' War—though all these happened in Chaucer's lifetime—but Chaucer's England, because it is Chaucer, the poet and teller of tales, who makes the living land of the 14th century live still in the 20th century.

The source of this living picture is *The Canterbury Tales.* The tales told by the poets, wandering minstrels, or tavern wits supplied the Middle Ages with the entertainment that people now seek in television, radio, films, and novels. The same tales were told over and over again—from the Classics, from the Bible, from France, Italy, and the East, or funny and usually vulgar stories of everyday life. Chaucer had the quite fresh plan of putting his stories into the mouths of a chance-gathered group of people on a pilgrimage to the shrine of St. Thomas Becket at Canterbury, so that he could tell every sort of story in a natural way.

Although its purpose was religious, a pilgrimage was also a way of taking a holiday, and Chaucer's pilgrims are in proper holiday mood. Thirty of them, including the poet, are gathered at the Tabard Inn, Southwark, and the jovial host, finding them such a cheerful company, proposes that they shall amuse themselves on the road by telling two tales each on the way to Canterbury, and the same on the way back, and when they reach the Tabard again the rest of them shall stand supper to the teller of the best tale. He himself will ride with them and be judge. Of 128 tales planned, Chaucer lived to write only 24, of which three are unfinished. But even that, as Dryden said, "is God's plenty."

On a sweet April morning they set out. In his Prologue, Chaucer describes them all—and the fine palfreys, solid cobs, or raw-boned hacks they ride. Between tales the Host takes charge, and the backchat that arises reveals more of their characters. Not even Shakespeare excels Chaucer in bringing people alive with a few lines of description or conversation. No one can fail to visualise that ambling procession in the spring sunshine.

First comes the Knight, the most important among them. He is the pattern of a good medieval knight; a valiant soldier — fresh from fighting the heathen — but modest, sweet-tempered, courteous:

A verray parfit, gentil knight.

GEOFFREY CHAUCER

This portrait of Chaucer comes from a copy of Thomas Occleve's poem "De Regimine Principum" (Concerning the Rule of Princes) now in the British Museum, London. Occleve (1368–*c.* 1450) was a close friend of Chaucer and paid many tributes to him in his moral poem.

His son, the Squire, is a charming young man, gallant and gay—

> Singing he was, or fluting, all the day;
> He was as fresh as in the month of May.

It is his tale that Milton, in "Il Penseroso," wishes Chaucer could be recalled to finish:

> The story of Cambuscan bold,
> Of Camball, and of Algarsife,
> And who had Canace to wife,
> That own'd the virtuous Ring and Glass,
> And of the wondrous Horse of Brass,
> On which the Tartar King did ride.

Then there are the Merchant, the Lawyer, the Seaman, a group of London master-craftsmen, and men of country trades—the lusty Miller and the Reeve (a sort of overseer on an estate)—who tell rude tales against one another.

The large number of pilgrims with various religious professions make a particularly interesting group for the student of medieval life. Not all of them are good examples to the laity. The wealthy, worldly Monk prefers hunting to cloistered meditation. The jolly Friar likes to preach to the gay and well-to-do, and has no truck with beggars. The Summoner, whose job is to summon sinners to ecclesiastical courts, and the Pardoner, who carries for sale pardons from Rome and sham holy relics, ride singing together. Both are cheats, and tell tales in keeping with their characters. To set against these there is "a good man of religioun," the poor town Parson, who serves his parishioners with the utmost love and devotion, and the Clerk, or clerical scholar, from Oxford, who tells the tale of Patient Griselda. Then there is the Prioress, a very refined and elegant lady, and so tender-hearted that she weeps to see a mouse in a trap. Another Nun rides with her, and both tell stories of martyrs. The good-natured Priest who attends her tells one of the most popular tales—a decked-out version of the old fable of the cock and the fox.

There is only one other woman—the plump, talkative Wife of Bath, with her scarlet stockings and outsize hat, her wide-spaced teeth that prove her born to travel, and her lively tales of her five husbands. She is among the greatest comic characters of English literature.

Chaucer's life—as much as is known of it—gave him ample opportunity to meet all kinds of people. His father was in the wine trade, and in the service of King Edward III, and Geoffrey is first heard of as a page in the household of

the wife of the king's son, Lionel, Duke of Clarence. In 1359 he went on a fighting expedition to France. He was taken prisoner, and the king helped to pay his ransom. By 1367 he was a yeoman of the king's chamber, which meant making beds and serving tables but also taking part in the life and entertainment of the court. Both Edward III and Richard II favoured him, and John of Gaunt was his patron and protector. Courtiers in those days were also civil servants. Chaucer was sent abroad on diplomatic and commercial missions, was given pensions for his services, and was made a comptroller of customs. He lived in the dwelling-house over the gate at Aldgate—a fine place from which to watch the world go by. But in 1386 he lost his customs post, and from that time he was much less prosperous, though he had more leisure for writing. His humorous "Complaint to his Empty Purse" may have moved the new king, Henry IV, to increase his pension in 1399. He then bought a house not far from Westminster Abbey, but died the following year and was buried in what is now called Poet's Corner—a fitting place for the father of English poetry.

Chaucer wrote much besides *The Canterbury Tales*. *Troilus and Criseyde*, which was adapted from the Italian, contains his loveliest poetry.

The Legend of Good Women includes the beautiful ballade that begins :

Hyd, Absolon, thy gilte tresses clere.

He was familiar with all branches of medieval learning, and wrote a treatise on the use of the Astrolabe, addressed to "Litel Lowis, my sone."

First among the English story-telling poets, England's first great literary artist, and a master of verbal music and conversational ease, Chaucer has left in his stories a gallery of pen portraits that is unequalled except by Shakespeare, Scott, and Dickens. He devoted himself to settling the English language into a form which made it an adequate instrument of poetry, and to enriching English literature from the treasuries of other countries.

It is not as difficult as it looks to read Chaucer in the original, but Nevill Coghill's spirited modern translation is an excellent introduction to *The Canterbury Tales*. Read them, and then, if you can, go to Canterbury, and see the stone steps worn by the knees of thousands of such pilgrims as Chaucer described. Meanwhile here follow two samples of the kind of tale the pilgrims told.

The KNIGHT'S TALE *of* PALAMON *and* ARCITE

WHEN the company of pilgrims had gone some two miles on their way, they drew lots to see who should tell the first story. The Knight drew the winning lot, and as they jogged along he began the tale of Palamon and Arcite, two cousins of the royal house of Thebes who had been taken prisoner by Duke Theseus of Athens.

One bright May morning (the Knight said) the lovely Emily, sister-in-law to the Duke, was walking in the royal garden beneath the tower in which Palamon and Arcite were prisoners. She was fairer than the lily and it would be hard to say which was fresher, the bloom of her cheeks or the colour of the rose. She was daintily attired, her yellow hair falling down her back in a long braid. Up and down the garden she wandered, gathering here a white flower and there a red one, to make a garland for her head. And all the while she was singing sweetly, with a voice that was like the voice of an angel.

Chancing to look through his barred window, Palamon caught sight of the beautiful Emily.

"Ah," he cried, pierced to the heart with love. "It is the goddess Venus herself!"

Then Arcite looked out, and he too was smitten with love and cried :

"Her fresh beauty will slay me! If I cannot have her grace, I am dead!"

Then, for the first time in their years of friendship, the two cousins began to quarrel.

Soon after, a friend of Arcite prevailed on Theseus to set him free. Theseus decreed, however, that Arcite must leave Athens at once, and that he should lose his head if he were ever found there again. So Arcite, though free, thought himself less fortunate than Palamon, who remained in prison ; for now he could not look upon Emily even from a distance. The time came when Arcite could bear the pain of absence no longer. Disguising himself as a labourer, he returned to Athens and took service with the Duke. Seven years had passed and Palamon was still pining in prison. At last one night he escaped. In a wood he chanced to meet Arcite, and the rivals fell to quarrelling again over the lovely Emily.

"Either you or I must die!" said Palamon. Arcite promised that the next day he would bring weapons, so that they might fight for the lady they both loved. They met as agreed, and while they were fighting fiercely Duke Theseus chanced to come through the wood on his way to the hunt. Queen Hippolyta rode with him, and with her was the lady Emily, clad in green.

"Hold!" cried the Duke, drawing his sword. "Who are you that dare to fight here?" When he heard their story, he cried angrily : "Your own mouths condemn you, and you shall both die."

Then the Queen and Emily began to weep. Falling on their knees they begged Duke Theseus not to treat two such gentle youths so cruelly. Relenting, the Duke made them this offer. At the end of 50 weeks, Palamon and Arcite should each bring 100 knights armed for the lists. They would hold a great tournament, and the victor should have Emily for his wife. Both joyfully agreed. When the day arrived, both sides fought bravely and well. Before the day was done Palamon was struck down and taken captive.

Then Theseus cried out : "Hold! The fight is over. Arcite of Thebes shall have the lady Emily, for he has fairly won her."

But just as Arcite, filled with joy, was riding proudly toward Emily, his horse stumbled and he was thrown heavily against his saddle-bow. His breast was crushed and he was mortally injured. When, in spite of all remedies, Arcite knew that he

must die, he sent for the lady Emily and his friend and rival Palamon to come to him.

"Alas!" he said, "after all the sorrow I have borne, I must die and leave you, my heart's lady. Raise me gently in your arms, I pray you, and hearken unto me. For love of you and from jealousy I have had strife with my dear cousin here for many a day. But to speak truly, there is no man so worthy to be loved of a fair lady as he. And if ever you should bethink you to become a wife, forget not Palamon." His breath then failed him and, still gazing at his lady, and murmuring "Emily," the brave knight passed away.

So great was Emily's sorrow that she wept day and night, and could not be comforted. Palamon, too, was bowed down with grief, and all Athens mourned Arcite. After some time had passed, Palamon and Emily were married. She loved him so tenderly, and he served her so devotedly, that never was there a harsh word between them.

The CLERK'S TALE *of* PATIENT GRISELDA

THE beautiful Griselda was the poorest maiden to be found in all the broad lands of the Marquess Walter.

The day set for his wedding had at last arrived, and great preparations had been made in the castle. The choicest dainties of the land were brought together for the feast. Costly garments and precious gems were set out ready to adorn the bride. The wedding guests were all arrived, but no one knew as yet what lady their lord had chosen to be the bride.

Then the marquess put himself at the head of the wedding party and bade them follow him to the village near by. As they reached the humble dwelling where Griselda lived with her father, she was just bringing a jar of water from the well. The marquess drew up his horse and called out to the peasant girl.

"Griselda," said Lord Walter, "I wish you to become my wife. Will you promise to obey me in all things and never complain whether I give you pleasure or pain?"

Trembling, Griselda replied: "My lord, I am not worthy of this great honour that you offer me. But if this be your will, it is also mine; and I swear that I will die rather than willingly disobey you in thought or deed."

Then the gentlewomen who were with Lord Walter robed her in beautiful garments in place of her poor attire, and placed a golden crown upon her head. The marquess set her upon a white horse by his side and conducted her in state to the palace, where the marriage was celebrated with feasting and joy.

As time went by, Griselda's kindness and virtue endeared her to all the people, and she made her husband very happy. But a foolish thought came to Lord Walter. He longed to put his wife to the test, that he might see whether her patience and steadfastness were as great as they seemed. One night, soon after a little daughter had been born to them, he came to his wife, and said: "Griselda, since your daughter was born my people have been greatly displeased, and I must do with the child as they choose."

"My child and I are yours," said Griselda, simply. "Do with us as you will." And Griselda only begged that she might be allowed to kiss her baby before they parted, although she believed the child was going to be killed.

A few years afterwards another child was born—a boy—and Lord Walter, who wished still to try his wife, told her the people were again displeased at the thought that the grandson of a lowly peasant should become their lord. Patient as ever, Griselda gave up her little son to her husband, as she had her daughter. Some years passed and, not satisfied even yet, the marquess one day came again to his ever-patient wife, and said:

"Griselda, my people urge me to take another wife, and I can do nothing but yield to their wishes."

Griselda bowed submissively before this blow. "My lord," she said, "I have always known that I was never worthy to be your wife or even your servant for so much as a day. I thank God that in my unworthiness you have honoured me for so long a time, and I pray Him to grant you happiness. I came to you with nothing at all. Even the poor dress that I wore was stripped from me, and by your grace I was clad in rich garments and jewels. Now here I give them back to you, with the wedding-ring that you placed upon my finger." And so, clad only in a peasant's smock, her beautiful head and feet bare, she went back to her peasant father's dwelling.

When the fair young bride came in state with her brother from Bologna, Lord Walter sent for poor Griselda to make the palace ready for the lady he was to marry. Faithful as ever, Griselda came at his bidding. When all the guests were ready for the feast, the marquess said to Griselda in jest, "Griselda, how do you like my new wife?"

"Right well, my lord," she replied. "I never saw a fairer bride. God grant joy to you and her. Only one thing I pray of you. Do not try her heart too sorely, for she has been tenderly brought up and could hardly endure such suffering as has been my lot."

The marquess was so moved by this that he cried out: "This is enough, Griselda mine! Now I know your steadfastness, dear wife.

"This maiden," cried he, "who you thought should be my wife, is our own daughter, and the boy beside her is our son. All this while they have been cared for by my sister in Bologna. Not through malice and cruelty have I kept them from you, but that I might know your heart."

Griselda swooned for joy. When she came to her senses she gathered her children in her arms, and tearfully thanked God for saving them and giving her back her husband's love.

For many a year thereafter the marquess and his wife lived happily together. In the course of time Lord Walter's son succeeded to the heritage. He too, married happily; but never did he put his wife to such a test as the patient Griselda had so long and so steadfastly suffered.

CHAUCER'S CANTERBURY PILGRIMS ON THE ROAD

Specially drawn for this work by Miguel Mackinlay

Most of the characters mentioned in the Prologue to the *Canterbury Tales* are seen here riding from the Tabard Inn in Southwark, London, towards Canterbury. In the right foreground is the gay and charming Squire, and on his right, also mounted, is the Monk, who prefers hunting to cloistered meditation. Immediately behind is the courteous Knight, who is speaking to the Wife of Bath, one of the greatest comic characters of English literature.

HOW MILK IS TURNED INTO CHEESE

The Dairyman

These pictures show some of the processes that turn liquid milk into solid cheese. In the upper left one, a cheese-maker in a New Zealand factory is preparing to cut the curd, which is milk shortly before it becomes solid. The cheese-maker in the top right-hand picture is piling curd on either side of a stainless steel tank so that the whey can drain off into the central channel. At the bottom is the blending room in an Australian cheese factory.

Cheese. The making of cheese was man's earliest attempt at dairying, and resulted from our distant ancestors' wish to preserve for winter use the food value of milk, which is always richest in summer. The first cheese was made by allowing milk to become sour, drawing off the whey or liquid, and letting the curd or solid part become dry. The curd was then salted to prevent it from going bad.

Milk from cows, goats, sheep, and even horses, was turned into cheese by the ancient Egyptians, Greeks, and Romans. But cheese was rather a tasteless food until it was discovered that the curd would keep without being dried, and if allowed to ripen during storage would develop an agreeable taste. Thereafter cheese-making became an art in which flavour was the most sought-after quality.

But although hundreds of differently flavoured cheeses were made, it was not until comparatively recently that a dairyman could be sure what flavour his cheese would have, or even if it would turn out good or bad. This was because no one knew what caused the flavour.

The ripening process produces in the curd various kinds of bacteria (see article), and it is the kind of bacteria in any particular cheese that gives it its flavour. Eventually scientists found it possible to cultivate any kind of bacteria, so that the dairyman can produce the flavour he wants. Of course the kind of milk used for making the curd and the length of time occupied in keeping and ripening have some effect upon the flavour, but the important thing is the nature of the bacteria.

Nearly all cheeses are made from fresh milk which is allowed to stand for a few hours so that it can ripen and develop the lactic-acid bacteria which will give the flavour. Sometimes the milk will develop enough of the required bacteria, but where large quantities of cheese are made the milk is "inoculated" by mixing with it some milk containing the desired bacteria.

When the milk is ripe it is slowly heated to about 84° Fahrenheit and curdled by adding to it rennet, a substance obtained from the fourth stomach of calves. Immediately the curd becomes compact and firm it is cut into small cubes and the whey, or watery portion, is drained off.

Chemical action then gradually knits the loose particles of curd together. The curd is again broken up and drained of any remaining whey, sprinkled with salt, and pressed into shaping moulds. The moulds are lined with cloth which will cover the finished cheese to keep it clean. The cheese is then left to ripen in a constant temperature. While this is happening, the bacteria are busy multiplying and so forming the flavouring substances peculiar to each kind of cheese.

During the ripening process some kinds of cheese become streaked with mould, which gives them a characteristic flavour and appearance. This mould is caused by the action of bacteria and also by the humidity, or dampness, of the place of storage. Sometimes the mould is induced in the cheese by the addition of a special mould culture.

Cheese is milk in a very concentrated form, and is actually a richer food than the milk from which it is made. It contains high percentages of fat, salts, and protein (see article), and is very rich in certain vitamins (see article). Over 90 per cent. of the cheese digested by the human body is changed into tissue or energy; properly ripened cheese is one of the most digestible of foods.

There are at present over 500 known varieties of cheese made from cows' milk, and new varieties are continually being added.

Dairymen classify cheese as hard or soft, according to the amount of water it contains and the method by which it is ripened. Some of the best-known cheeses, their characteristic qualities, and the places where they were originally made are: Brie, soft white cream, France; Camembert, soft, rich, France; Cheddar, a hard cheese, England; Cheshire, hard, dry, reddish, with a crumbly texture, England; Danish Blue, soft, white, with bluish-green mould; Edam, hard, mild, pressed into round moulds and dyed red on the outside, Netherlands; Gorgonzola, soft, white, fully-flavoured, with green mould, Italy; Gruyère, hard, yellow-white cheese having many holes caused by gas fermentation, Switzerland; Limburger, soft,

John Topham

CHEESE MARKET IN THE NETHERLANDS

One of the sights of Alkmaar is the cheese market, which is reputed to be among the oldest in the whole of the Netherlands. Here the white-clad porters are carrying "boats" (trays) of the round Edam cheese.

with a very strong flavour and smell, Netherlands; Parmesan, hard, greenish, Italy; Roquefort, soft sheep-milk cheese, with mould streaks, France; Stilton, fairly hard, mould-streaked, with a strong flavour, England. Processed cheese is any kind which is cooked after it has been made, and has no rind. Common examples are the triangles of soft cheese wrapped in silver paper and packed in round boxes.

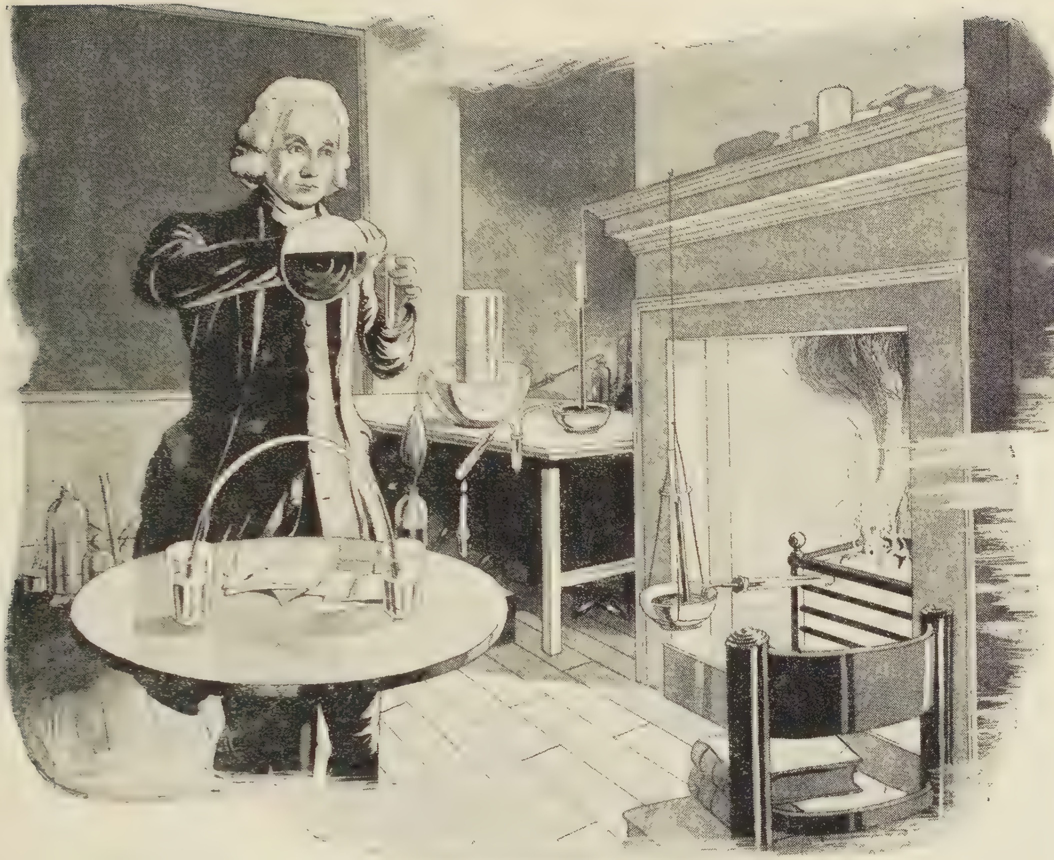
Cheltenham. Lying in a valley sheltered by the Cotswold Hills, Cheltenham is the third largest town in Gloucestershire. The population in 1951 was 62,823. It is unsurpassed in the country for its spacious Georgian elegance, and the famous physician Lord Horder called it "a centre for purveying the combination of health, rest, beauty and quiet—those inestimable things which people need more and more." Its growth from a small village to an inland watering-place originated in the discovery of a saline spring in 1716. In 1738 a certain Captain Skillicorne built the first spa, but the event which set the seal on Cheltenham's future was the visit of George III, with the Queen and Princesses, in 1788. Though the Cheltenham waters could do little for his madness, the news that the King walked and rode informally around and about the town attracted large and fashionable crowds. Charming, graceful buildings were erected by craftsmen who "worked for Time and not for a limited company"; many kinds of trees were planted along the thoroughfares; and assembly rooms, parks, museum, and library followed the advent of residents, who came as much for health as for social reasons. For apart from the famous waters, once considered a sovereign remedy for dyspepsia and kidney troubles, the mild air found favour with those who had spent long years in the East. So many Anglo-Indians retired to Cheltenham that it is sometimes referred to as "Asia Minor." In winter it is a centre of fox-hunting.

Cheltenham is an important educational centre, with Cheltenham College (founded 1841), Dean Close School (1886), and Cheltenham Ladies' College (1853). This last was a pioneer public school for girls, and Miss Dorothea Beale, who became its headmistress in 1858, exercised a great influence on the development of girls' education. Training and technical colleges are now added to these older establishments and Cheltenham's many private schools.

On the Promenade, a wide and beautiful thoroughfare, there is a memorial to the town's heroic son, Dr. Wilson, who perished with Captain Scott in Antarctica. Cheltenham, the cradle of Australia's famous poet, Adam Lindsay Gordon, is the grave of her great explorer, Charles Sturt. James Elroy Flecker is also buried here. The composer Gustav Holst (1874–1934) was born here. The list of famous people associated with this "town among trees" is a long one. There was a certain amount of industrial development during the 1950s.

PLANNING OF CHELTENHAM SEEN FROM THE AIR

A Gloucestershire health resort situated in the heart of the Cotswolds, Cheltenham has grown according to plan, not in a haphazard manner. The imposing crescent of Georgian houses near the lower left-hand corner is Royal Well, and in front of it is the tree-lined Promenade, a wide and beautiful thoroughfare. Note the tidiness without monotony. The aircraft is a Gloster Javelin fighter, which is the product of a factory not very far from Cheltenham.



JOSEPH PRIESTLEY IN HIS LABORATORY

This drawing resembles closely a picture in Priestley's own book *Experiments and Observations on Different Kinds of Air,* published 1774–81. On the bench are two pieces of apparatus for collecting gases. In the farther one the gas (probably hydrogen) given off by some mixture in the jar below passes through a bladder (used before rubber tubing was invented) to be collected in a vessel inverted over water. In the nearer apparatus the gas produced from some substance in a test tube heated by a candle passes through a drying device before being collected over mercury. In the fire a third substance is being heated in a gun barrel, producing gas.

WHAT *the* WORLD IS MADE OF

Chemistry. To the average person, chemistry is either a form of black magic practised in the back rooms of chemists' shops, which produces anything from cough mixtures to penicillin prescriptions ; or it is a succession of rather messy experiments involving a variety of bangs, colours, and smells (usually unpleasant), carried out with the chemistry set that most boys receive as a present at some stage in their school career. On the other hand, cynical schoolboys preparing to be cabinet ministers, judges, or playwrights, usually dismiss chemistry as an inferior kind of cookery. Like most hazy ideas, all these views of chemistry contain some element of truth, since chemistry consists essentially in making new substances, and the main job of the chemist, whether he works in a research laboratory, factory, school, shop, or kitchen, is to change one substance into another.

Of course, chemical changes can take place without the help of chemists and are going on around us all the time. The most important of all, on which man depends for his very life, is not controlled by him, nor indeed does he know how it occurs. This is the conversion by green plants of carbon dioxide from the air into sugars and oxygen with the help of sunlight and water. At this moment, you are breathing in this oxygen, which is reacting with the sugars in your body to produce energy and more carbon dioxide. (*See* PHOTOSYNTHESIS.)

Another important chemical process going on in nature is the slow decay of vegetation to form oil and coal. A spectacular one is the formation of stalactites and stalagmites on the roofs and floors of limestone caverns. (*See* CAVE.) These consist of calcium carbonate, which is deposited when hard water is exposed to air. So-called hard water contains calcium bicarbonate, which is easily split up by heat. Thus, when hard water is boiled in a kettle, carbon dioxide is evolved and calcium

carbonate is once again deposited, this time in a loose powdery form known as " fur."

Unwelcome chemical changes are the rusting and corroding of metals. Very few metals occur free in nature, but many are found in rocks in compounds containing oxygen. As soon as they have been extracted from their ores—another chemical process—they attempt to revert to their natural state by reacting with water and the oxygen in the air. If the metal in question is iron, the process is called rusting.

Discoveries by Chemists

These few examples are enough to show that chemical change is as old as the world itself and is in fact an essential feature of it. Man was not long on earth before he began to carry out chemical changes for himself, and one of the earliest, the heating of clay to make pottery, has been known for 10,000 years. The discovery of fire was made by prehistoric man, and the arts of dyeing and of glass-making were practised among the ancient Egyptians. In fact, these two old crafts may well be described as among the first manufacturing processes, and to-day they form the basis of large chemical industries.

The highly-prized dye of Roman times, Tyrian purple, which was used to dye the cloaks of the Roman emperors, was obtained from a shell-fish in the Mediterranean. This dye is a derivative of indigo, which has been known for over 3,000 years and which, up to the end of the 19th century, was obtained from a plant grown in India. Then, in 1897, chemists succeeded in making indigo from chemicals more cheaply than nature herself could produce it. The land formerly devoted to the production of indigo is now almost entirely given over to the growing of food, and so the benefit derived from the chemists' work is twofold.

As for glass, it is difficult to estimate how much mankind owes to the first glass-makers. As Dr. Johnson, the great dictionary-maker, wrote, " the first artificer in glass was facilitating and prolonging the enjoyment of light, enlarging the avenues of science, and conferring the highest and most lasting pleasures ; he was enabling the student to contemplate nature and the beauty to behold herself." In modern times glass has undergone a wonderful evolution through the work of chemists, who have shown how, by varying the composition, the properties of glass can be altered enormously. The production of different kinds of glass has made possible prisms and lenses for lighthouses, microscopes, telescopes, and other instruments, heatproof utensils for cooking, and splinterproof windscreens for cars. (*See* GLASS.)

Chemists are not of course only concerned with improving old processes or preparing natural substances artificially. They are very often engaged in making some new material to meet some new need. Metals like stainless steel and light alloys such as " Duralumin," which do not break or rust so easily as the old ; fibres like nylon and " Terylene," which make life a great deal easier, more comfortable, and cheaper ; plastics such as bakelite, P.V.C., polythene, and " Perspex " ; weed and pest killers to increase the world's food supplies ; drugs such as M. and B. and antibiotics such as penicillin to prolong and save life ; and even explosives.

How does the chemist set about his many tasks ? Does he trust to chance, hoping that some lucky discovery will put him on the right road, or does he start with a certain amount of knowledge which will enable him to carry out his experiments in the way most likely to bring success ? He nearly always works in the second way, although many of the great discoveries in science can be considered as accidental, for example Sir Alexander Fleming's discovery of penicillin and Pasteur's of antitoxins. But as Pasteur himself said, " Chance favours only the ready mind." Knowledge is gained as the result of hard, patient work based on that of earlier workers. This previous knowledge enables the chemist to adjust the conditions of his experiment to the most favourable, and if anything goes wrong he can nearly always find out why and put things right next time. As an interesting example of the way in which a modern research chemist works, here are the words of Sir Alexander Fleck, Chairman of Imperial Chemical Industries, Ltd., one of the largest chemical manufacturers in the world : " This research started with the clear objective of finding an anaesthetic which would be certain in its action, safe in prolonged application, free from unpleasant after-effects, and in addition non-inflammable. The search for such a material was guided by a systematic study of chemical structure in relation to these requirements, and the successful outcome of the work can be attributed to a combination of the basic and logical thinking in the initial stages of one mind, and, later on, the planned co-operative work of a number of teams of investigators."

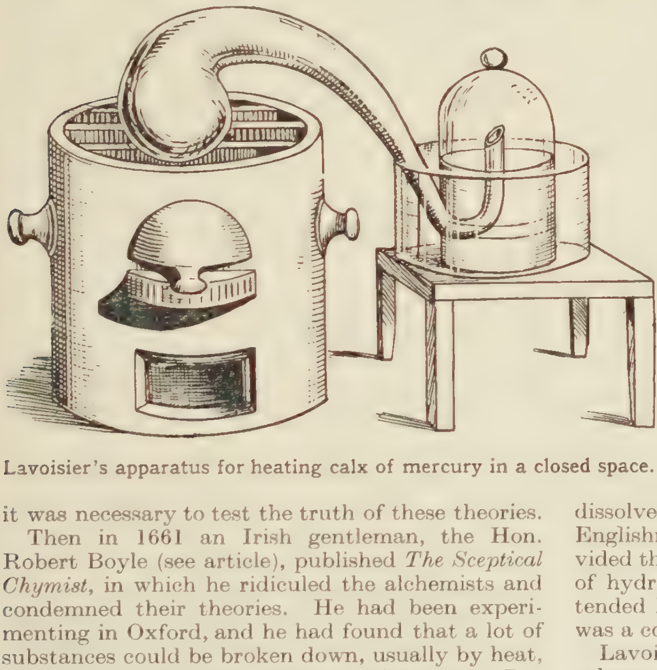
Early Atomic Theory

But chemists have not always worked in this methodical way. In fact, they have done so for only about the last 150 years. As we have said, the idea of chemical change is by no means new, but in far-off times nobody knew why some changes occurred and some did not. The ancient Egyptians were great experimenters, but they could not explain what they were doing. The old Greek philosophers, although keenly interested in everything that went on around them, considered experimental work to be beneath their dignity as it unfitted their minds for the study of loftier topics such as mathematics (particularly geometry) ; and they contented themselves with revising various theories to account for the origin and constitution of matter. To most of them, the world consisted of four " elements "—earth, air, fire, and water. If a stick burns, what happens ? Fire comes out of it ; smoke rises and disappears into air ; water oozes out of the end ; ash is left, and ash is a kind of earth. Clearly, therefore, the stick is made of earth, air, fire, and water, and so presumably is everything else in the world. One philosopher, Democritus, however, said that the universe was made up of two things : small hard bodies which he called atoms, and empty space. But Aristotle disliked the idea of nothingness, and as he was more highly regarded than Democritus, very few people believed in the " atomic theory " ; and another 2,000 years were to pass before its essential truth was recognized. (See articles on ATOM and ELEMENTS.)

The trouble with the four-element theory was

that it explained nothing and led nowhere. Men went on using the old recipes which had been discovered more or less by chance and handed down by masters to apprentices as mysterious trade secrets. From time to time one of them stumbled on a way of making a new substance such as an acid, an alkali, a glass, a metal, a pigment, a glue, a dye, or a medicine. But chemical knowledge was a mass of unrelated facts, there was no adequate theory to explain chemical changes, and progress was very slow.

During the Middle Ages a theory did emerge known as alchemy (see article), and an incredible amount of thought and labour was devoted to the search for the "philosopher's stone," which was believed to convert cheap metals like lead into gold. The idea of getting rich quickly is not very new! It is not surprising that the alchemists failed to convert chemistry into a science, since their efforts were directed to the discovery of definite substances, such as medicines; and the old theories, founded on imagination, were so vague that they could explain only the more obvious properties of things in general. No one seemed to think that it was necessary to test the truth of these theories.



Lavoisier's apparatus for heating calx of mercury in a closed space.

Then in 1661 an Irish gentleman, the Hon. Robert Boyle (see article), published *The Sceptical Chymist*, in which he ridiculed the alchemists and condemned their theories. He had been experimenting in Oxford, and he had found that a lot of substances could be broken down, usually by heat, into two or more quite different substances. But some could not be broken down. He described these as "Primitive and Simple, or perfectly unmingled bodies," and insisted that if it was desired to discover the real elements out of which the world was made, it was necessary to find by experiment what substances cannot be broken down into simpler substances, and not just repeat parrot-fashion the old rigmarole about earth, air, fire, and water. Boyle has often been called "the father of modern chemistry," and although 100 years elapsed before the older ideas were finally done away with, he certainly breathed a new spirit of inquiry into chemistry which has inspired men ever since.

For the next 150 years chemists all over Europe were busy trying to find out what substances were "elements" in this new sense. They made a lot of mistakes at first. It took a long time, for instance, to discover that air and water were not elements, but that there were a number of quite different gases, and that air was a mixture of several of these while water was a compound of two of them.

A German chemist, G. E. Stahl (1660–1734), led everybody astray with a theory about fire. Fire, he said, was the visible form of a fluid called phlogiston. Charcoal and other inflammable materials contained a great deal of phlogiston which escaped as flame when they burned. If mercury was heated for a number of days to just below its boiling-point, it became covered with a reddish earthy substance called calx of mercury. If this calx was thrown in a charcoal furnace, it changed back to the metal. On Stahl's theory the calx was the pure substance or element; the metal was a compound of the calx and phlogiston coming out of the charcoal.

It was not until a Frenchman, Antoine Lavoisier (1743–94: see article), began to study combustion and the oxidation (or calcination, as it was then called) of metals that the phlogiston theory was finally disproved. He noticed that sulphur and phosphorus gained weight when they burned, and he supposed that they absorbed air. The key to the explanation of his own observations came when Joseph Priestley (1733–1804: see article), an English chemist, discovered oxygen. Priestley thought of this as air without its phlogiston and so failed to recognize it as an element. Lavoisier gave it the name oxygen and soon showed that it was the substance that was absorbed by metals when they formed "calces," that is, oxides. He then proceeded to replace the phlogiston theory by the correct view that combustion is a chemical combination of the burning substance with oxygen. At first Lavoisier's theory failed to account for the combustion of "inflammable air" (hydrogen), evolved when metals were dissolved in acids. Here, a discovery by another Englishman, Henry Cavendish (see article), provided the clue. Cavendish learned that the burning of hydrogen produced pure water. Lavoisier extended his experiments and concluded that water was a compound of oxygen and hydrogen.

Lavoisier accepted Boyle's view of elements as substances from which nothing different could be obtained by decomposition, and he compiled a list of elements (or "simple substances," as he termed them) which included the metals; the better-known solid non-metals; the gases oxygen, hydrogen, and nitrogen; and light and heat. Certain substances such as lime, magnesia, and alumina were counted as elements, for at that time they had not been split up. The adoption of this idea, together with that of the new theory of combustion, created a revolution in chemistry. It called for a new system for naming substances, and French chemists set about doing away with the old meaningless names and introducing ones based on composition. With a few revisions, this new system is still in use to-day.

Modern chemistry begins with the atomic theory of John Dalton (see article), who adapted the theory of Democritus to explain the relationships between the amounts of chemical elements in chemical compounds. To him we owe the ideas of atomic weight and chemical formulae, ideas which started three big problems in chemistry—first, the relationship between the relative weights of atoms of elements (atomic weights) and the proportions in which those elements combine; second, the way in which the atoms are grouped in molecules; and third, the nature of the forces that group them.

Use of Symbols

Dalton invented symbols to represent atoms of different kinds and was thus able to show chemical relationships pictorially. These symbols had no reference to the names of the elements and they were replaced by a simpler system devised by a Swedish chemist, Berzelius, about 1818.

In this scheme a molecule of sulphuric acid is represented as H_2SO_4. This indicates that it contains two atoms of hydrogen, one atom of sulphur, and four atoms of oxygen. This chemical shorthand allows chemists to express a great deal of information in a small space. For example, if you dissolve iron filings in dilute sulphuric acid, inflammable hydrogen comes off and, after filtering the black mess, green crystals of ferrous sulphate appear. All this can be expressed by:

$$Fe + H_2SO_4 = FeSO_4 + H_2$$

This equation summarises several of the basic principles of chemistry which enable modern workers to plan their experiments and predict the results. First, it shows that a molecule of ferrous sulphate always contains one atom of iron, one atom of sulphur, and four atoms of oxygen; and as all atoms of one element are chemically alike, this means that these elements always occur in ferrous sulphate in the same proportion of 56 (atomic weight of iron) : 32 (atomic weight of sulphur) : 64 (4 × atomic weight of oxygen). No matter how substances are made and in what physical form they occur, they always contain the same elements in the same ratio by weight. Secondly, it indicates that when substances react together, they always do so in the same proportions. Thus if the chemist takes 56 pounds of iron, he will need $(2 \times 1) + 32 + (4 \times 16)$, i.e. 98 pounds of sulphuric acid, and will get 152 pounds of ferrous sulphate and 2 pounds of hydrogen. Notice that there are 154 pounds of material on each side of the equation, which shows that matter cannot be lost or created in a chemical reaction.

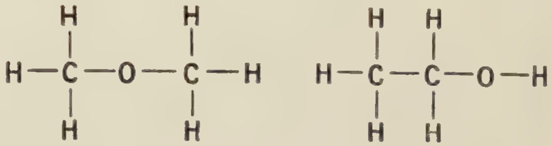
There is, however, one important fact which the equation does not reveal, and that is how the atoms in the various substances are arranged. All the properties of substances are controlled by the structure and arrangement of their molecules and on the presence of reactive groups which can be picked out by means of certain reactions. With simple substances it is usually quite easy to determine the structure by considering what may be called the combining power of the atoms it contains. It is known that a molecule of water consists of two atoms of hydrogen and one atom of oxygen, and is represented by H_2O. What is not known is whether the atoms are arranged like this: "H O H" or like this: "H H O." Long before modern theories of the atom provided an explanation, it was known that hydrogen had the property of combining with one other element and oxygen with two. This being so, the molecule of water must be "H–O–H" and cannot be "H–H–O" since this would give one hydrogen atom a valency of two and leave the oxygen valencies unsatisfied. It is now known that the three atoms are not in a straight line nor in the same plane.

As soon as the student turns to more complicated substances like plant pigments, vitamins, proteins, perfumes, etc., the job of assigning a particular structure to a particular molecule becomes more difficult. Most naturally-occurring substances are made up of very few elements, namely, carbon, hydrogen, nitrogen, and oxygen, and occasionally phosphorus, sulphur, and some metals. During the 18th century the belief grew up that all animal and vegetable substances were produced under the influence of a particular vital force, and that their formation was regulated by laws quite different from those which governed the formation of mineral substances. Substances from non-living matter were called inorganic and those from living matter were called organic.

Organic Chemistry

But in 1828 a German chemist called Wohler transformed ammonium cyanate, a typical inorganic compound, into urea, a typically organic one, and thus effectively exploded the theory of vital force. The supposed difference between the two classes of compounds having been destroyed, the terms organic and inorganic lost their original meanings, and organic chemistry is now taken to mean the chemistry of carbon compounds, of which there are about 200,000, more than all the known compounds of every other element. The reason for this vast number of compounds is the unique property which carbon atoms have of joining up into chains, rings, and combinations of these. Owing to this property, some carbon compounds, particularly the proteins, contain very large molecules. A relatively small molecule like haemoglobin, the colouring matter of the red cells of the blood, has the formula $C_{758}H_{1203}O_{218}N_{135}S_3Fe$ and can be seen quite easily under the electron microscope. It is quite obvious that the formula written in this way gives no information about the properties of haemoglobin, and therefore when dealing with organic compounds a different procedure must be adopted.

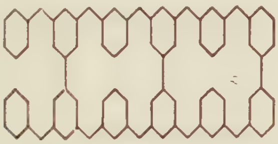
Suppose there is a compound with the formula C_2H_6O. If each atom is written down separately and each one is given its correct valency (C, 4; H, 1; O, 6) it will be found that two structures are possible:



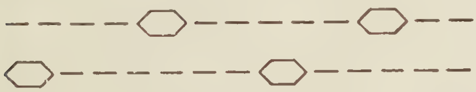
I II

Structure I represents a substance that is called dimethyl ether, an unreactive, uninteresting compound, and II is the formula of ordinary alcohol, or, more correctly, ethyl alcohol. This is a reactive substance and as it differs from the ether in having an OH group, it is reasonable to assume that its chemical properties are mainly the properties of this group. The existence of more than one compound with the same chemical formula shows how important it is to write structural formulae wherever possible. Theoretically, the hydrocarbon $C_{40}H_{82}$ can exist in 62,481,806,147,341 different forms! Also, a structural or graphic formula shows how the atoms are grouped within the molecule, and thus provides information on its chemical properties. Perhaps most important of all, it shows how the substance may be made from simpler chemicals. When chemists set out to build up or synthesise large molecules, they rely on an accurate picture to indicate how to proceed. For instance, in the synthesis of insulin, the protein which controls the amount of sugar in the body, it is necessary to know the order in which the amino acids of which it is composed are arranged in long chains and how these chains are linked together. This was established by breaking down the natural substance in separate small stages.

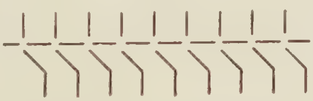
Besides the proteins, other interesting examples of giant molecules are rigid plastics such as "Bakelite," in which the molecules are linked to form a continuous compound:



fibres like "Terylene," in which the molecules lie alongside each other after being stretched straight:



glass-like materials such as "Perspex," where long side-chains of atoms attached to the main chains prevent the molecules from lying close together and thus developing the strength of fibres:



and elastic products such as isoprene rubber, unstretched:

or stretched:

which have no tendency to remain stretched but coil up again into the smallest space when the stretching force is removed.

It has been shown how the chemist can make the dye indigo much more cheaply than nature can grow it. But this is not always so. The first compound to be used as a local anaesthetic, cocaine, occurs in the leaves of the coca tree in Peru. Once pure cocaine was obtained from the plant and its chemical structure was established, chemists set about preparing it in the laboratory. Unfortunately the synthesis required seventeen successive reactions, and one ton of the starting materials gave only $\frac{1}{4}$ oz. of cocaine. It is therefore cheaper to grow the coca trees. However, this is where a complete knowledge of the structure of the molecule proved useful. By making substances very similar to cocaine and testing their properties, it was found that only four groups of atoms in the cocaine molecule are essential, although different groups may be helpful. Out of several thousand compounds prepared, novocaine and percaine proved in the end to be more active than cocaine.

Results of Research

Ease of synthesis, and therefore cheapness, is very important in these compounds, which are designed to be substitutes for, or improvements on, a natural product. A few other examples are worth mentioning. As one result of the Japanese conquests during the Second World War many important compounds became unobtainable, among them quinine and the only two useful insecticides, pyrethrin (from tropical chrysanthemums) and rotenone (from Malayan derris root). Although substitutes for quinine, with a similar chemical pattern, were available, none was as good, and in 1944, the very year in which quinine was first synthesised, a new compound, paludrine—of a completely different chemical constitution—was produced, which is far superior. Similarly, the search for artificial insecticides produced more effective agents, namely, D.D.T. and Gammexane or B.H.C.

The danger that the world's natural resources may become exhausted, and the need to conserve sources of raw materials, have also provided a keen incentive to the chemist in his search for new substances and methods. The scarcity of petroleum in Britain and the probability that petroleum reserves will run out before those of coal, have led to research into methods of converting coal into oil. Other fuels under active investigation are electricity, atomic energy, and alcohol, all of which will increase in importance as the need for smokeless and less wasteful fuels increases.

New sources of food have been found with margarine made from otherwise inedible oils, sugar from beet; and large increases in agricultural yields have come about through the use of fertilisers. The production of margarine is a good example of the way in which an investigation of apparently only academic interest turns out to be of far-reaching importance. Essentially, the problem is to convert liquid fats, such as whale oil and linseed oil, into solid fats like margarine, by reacting them with hydrogen. This reaction was not feasible on a large scale until it was found

OLD ALUM WORKS AT HURLET, SCOTLAND

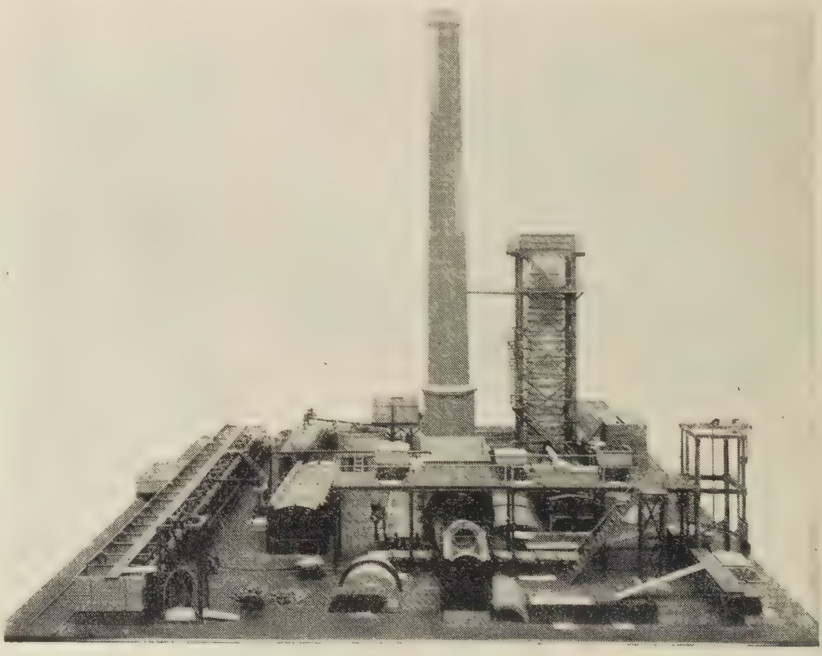
At one time the largest alum plant in Great Britain was situated at Hurlet, Renfrewshire, Scotland. The manufacture of alum, which is used in the dyeing industry as a mordant (colour fixer), and in sizing paper, began in Scotland towards the end of the 18th century.

that it proceeded very smoothly if carried out on finely divided nickel. Presumably the nickel particles form a surface on which the molecules of oil and hydrogen can come together and react. Incidentally, if there is added to a piece of margarine a solution of a substance called dimethylglyoxime, the red colour of the compound which this forms with nickel will be seen. This test is sensitive enough to detect one part of nickel in several million, so that there need be no fear in eating the margarine! The introduction of this hydrogenation, as it is called, has led to a great expansion of the whaling industry and also to an increased demand for oil-producing plants such as groundnuts and soya beans, with very healthy effect on the trade and commerce of the countries where they are grown.

As a final example of the way in which man tries to solve all sorts of problems with the aid of chemistry, the famous German chemist Fritz Haber tried to pay off Germany's debts after the First World War by extracting gold from sea water. Although there is more gold in the sea than in the earth, there is still not enough to make its recovery at all profitable and Germany had therefore to find the money in some other way.

In this short account an attempt has been made to indicate the scope of chemistry and some of the ways in which it caters for man's needs from the growing of food to the conquest of pain and disease. The doctor with his drugs, antibiotics, and anaesthetics, the farmer with his fertilisers, the gardener with his weed-killers and plant hormones, the housewife with her glass ovenware, silicone polishes, and plastic washing-up bowls, and the business man with his nylon socks—all may well be grateful to the chemist.

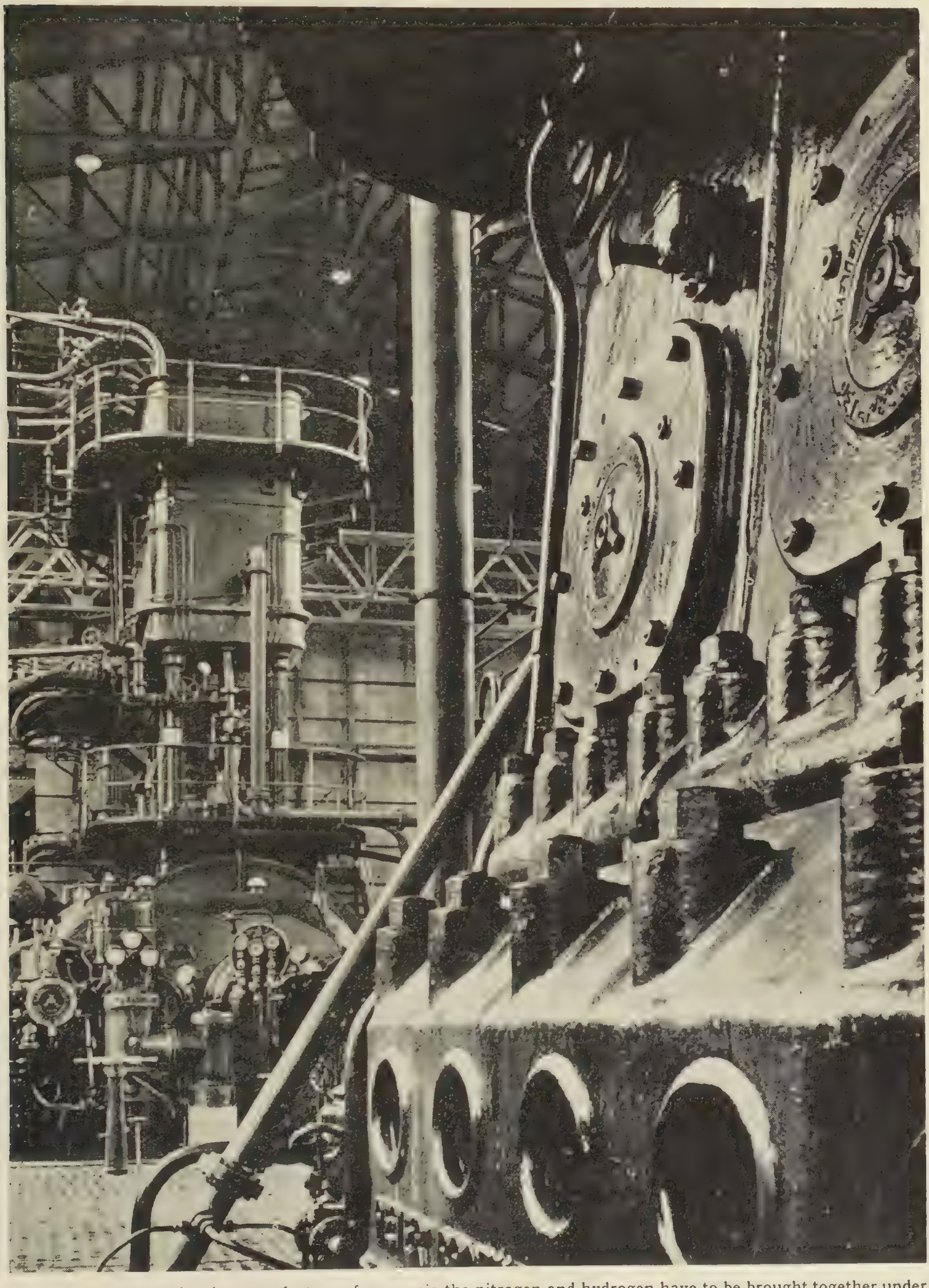
But it would be wrong to think that these chemicals, fascinating as they are, represent the bulk of those made. The greater part of the chemical industry is engaged in the manufacture of more ordinary, simpler compounds like acids and alkalis, hydrogen, nitrogen, chlorine, soda, and alcohol, the so-called heavy chemicals. These chemicals are essential, as they are often the starting materials for more complicated substances. Every year 30,000,000 tons of sulphuric acid are used, one quarter of it in the manufacture of "superphosphate" fertiliser, since at £10 per ton it is by far the cheapest acid. It is also used to help make rayon, detergents, sulpha drugs, "Cellophane," ether, guncotton dynamite, T.N.T., and D.D.T. Disraeli's saying is still true, that "there is no better barometer to show the state of an industrial nation than the figure representing the consumption of sulphuric



MODEL OF AN OLD ALKALI PLANT

This model, which is in the Science Museum, South Kensington, London, shows the kind of plant used for making soda by a process invented by the French chemist Leblanc. The tall chimney carried away the fumes given off by the sulphuric acid.

MAKING AMMONIA WITH NITROGEN FROM THE AIR



In the Heber process for the manufacture of ammonia the nitrogen and hydrogen have to be brought together under high pressure (about 350 atmospheres) and a temperature of some 500° Centigrade to make them combine into ammonia, NH_3. The picture shows some of the complicated machinery used to compress the gases. On the right are the containers. These compressors are at the Imperial Chemical Industries plant at Billingham-on-Tees.

CHEQUERS : EVERY BRITISH PRIME MINISTER'S COUNTRY HOME

Prime Ministers boasted only one official residence—Number 10, Downing Street, London—until the home of Lord Lee of Fareham, known as Chequers, in Buckinghamshire, with all its beautiful furniture, became available in 1921 for that purpose. The house, built in the 16th century on the site of an earlier one, is 38 miles from London. The estate covers about 1,500 acres, and on it is Coombe Hill (852 feet), one of the highest points of the Chilterns.

acid per head of population." Nitrogen is used in large amounts to make ammonia, needed for fertilisers and as a source of nitric acid. In turn, nitric acid is important in the production of explosives such as T.N.T. and nitroglycerine. Chlorine is a by-product of the manufacture of caustic soda, which is used to make soap. Research into uses for this waste product led to the discovery of many useful chlorine compounds, including P.V.C., chloroform, T.C.P. and "Dettol," and trichlorethylene, used in dry cleaning.

In trying to assess future developments in chemistry, two important facts must be borne in mind. One is that it is impossible to tell whether new knowledge will ever have a practical use. Lord Rayleigh and Sir William Ramsay wondered why the density of nitrogen obtained from the air was always greater than that of nitrogen prepared from its compounds, and discovered that it was because of the presence of a heavier inert gas in the air; but they could not then have foreseen that this gas, which is called argon, would one day be produced in large amounts from liquid air for filling incandescent electric-lamp bulbs, for use in the welding of aluminium and its alloys, and to provide an inert atmosphere during the manufacture of the reactive metal titanium. The second fact is that a considerable time often elapses between the discovery of a new substance and its practical application. Although polyhexamethylene adipamide, better known as nylon, was first prepared in about 1931, nylon stockings were not on sale until 1940 (in America).

Nevertheless it is not difficult to pick out a few problems which have still to be solved. A great deal of time and money have already been spent in seeking a cure for cancer, so far without very much success. The world's store of metals is slowly being worked out, and substitutes such as alloys and plastics are finding increasing application. New metals are coming into use: titanium, which combines strength with lightness; germanium, which has unique electrical properties; liquid sodium, which is an excellent conductor of heat; zirconium, which is used in the construction of atomic reactors; uranium and plutonium for atomic energy; and radioactive isotopes of cobalt, whose radiations have useful medicinal properties. Another big problem is that of fuel supplies, and here, in the words of Sir John Cockcroft, director of the Atomic Energy Research Establishment at Harwell from 1946 to 1958, "the application of nuclear fission, wisely guided, can ensure that for a millenium ahead mankind has all the energy needed to supply his ever-growing needs." The feeding of the world is also a tremendous task, and the search for more effective fertilisers, weed-killers, and insecticides still goes on.

Whatever the demands made upon him by engineers, doctors, biologists, farmers, and men in all spheres of human activity, there is no doubt that the chemist will provide the answer, whether it be in the form of a new material or a cheaper and easier method of manufacture. (*See also* articles on subjects like Atom, Colloids, Crystals, Ions, and on the various elements and products, *e.g.* Hydrogen, Sulphuric Acid.)

Chequers. Six hundred feet above sea-level on a slope of the Chiltern Hills among the beechwoods of Buckinghamshire, 38 miles from London, stands Chequers, the official country residence of the prime minister. No traces are visible of the original mansion called Chekers, whose name was probably a corruption of that of the first owner, Helyas de Scarccario, or de Chekers, keeper of the exchequer to King Henry II

(1133–89). A small portion of the present building dates from about 1326, but it was remodelled in 1565. The mansion and the estate, which covers some 1,500 acres, including Coombe Hill, one of the highest points in the Chilterns (852 feet), were presented to the nation in 1917 as a country home for each prime minister during his term of office by Sir Arthur Lee, M.P., afterwards Lord Lee of Fareham, but they were not made use of until 1921. In the grounds of the estate are the ruins of an ancient British stronghold, Cymbeline's Castle, where the British chieftain Caractacus is supposed to have been born about A.D. 1.

Cherry. Of all the fruit-producing members of the rose family (*Rosaceae*), the cherry tree is the most beautiful. There are three wild kinds in Great Britain. The commonest is the gean, or mazzard (*Prunus avium*), a graceful, tapering tree most plentiful on chalky soils, where it reaches 80 to 100 feet in height. In April its young pinkish-brown leaves are almost hidden by clusters of rather frail white flowers, but when the petals have fallen the leaves enlarge and become green. The dark red or nearly black fruit is quite pleasant to eat, and long cultivation has produced the sweet dessert Black-heart and Bigarreau varieties from the gean. The bird cherry (*Prunus padus*) is a smaller, round-topped tree, very common in northern England, Scotland, and Scandinavia. Its flowers are more cup-shaped and have thicker petals than those of the gean, and do not occur in such tight clusters. The small black cherries are very bitter. The dwarf cherry (*Prunus cerasus*) is the ancestor of Morello and Kentish cherries. It is a large bush rather than a tree. The dark red Morello and the Kentish red cherry are too sour to eat like the sweet dessert kinds; they are used for cooking and for making cherry brandy.

All cherry flowers are sweetly scented, but when the bees come for nectar they find it in little swellings on the leaf stalks, and take only pollen from the flowers. The fruit, like the plum and peach, is known botanically as a drupe. When it is tiny and green there is no stone; this forms round the seed by the hardening of the innermost part of the fruit. Cultivated cherry trees are grown by grafting on stocks (stems) of wild cherry. The wood of cherry is reddish brown and can be highly polished, so it is used in cabinet making. The dark, red-brown, satiny bark is marked by thin greyish rings round the trunk and boughs, and can be peeled off in strips. Other kinds of cherry grow wild in Europe, Asia, and North America, and most of the decorative garden varieties come from Japan or China, where they have been cultivated for hundreds of years.

A. W. Dennis

CHERRY BLOSSOM AND FRUIT

In spring the white cherry blossom appears. Fruit of a wild cherry (right) is considerably smaller than that of the cultivated varieties of our orchards, but the starling (a great cherry-eater) does not despise it.

Cheshire. It has been said that Cheshire looks like a teapot on the map, the Wirral Peninsula (between Mersey and Dee) forming the spout and the narrow stretch between Derbyshire and Lancashire making the handle. Though its gently undulating land and rich soil make agriculture a flourishing industry—Cheshire's reddish cheese is famous—the county has chemical centres; and shipbuilding, at Birkenhead on the Mersey, provides much employment. In 1950 there was built at Capenhurst, near Chester, a large centre for the production of atomic energy; and as the 1950s drew on, that portion of the Wirral containing Bromborough and Ellesmere Port became more and more an industrial region.

Chester (see article) is the county town. The area of Cheshire is 649,424 acres, and the population (1951) 1,258,507.

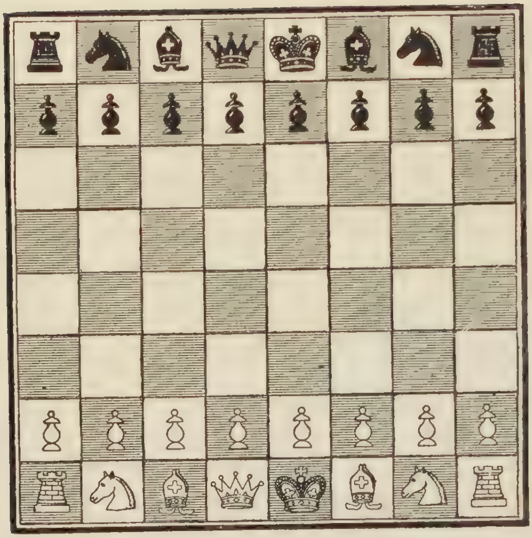
Some coal is mined, and more salt is found within the county borders than has been discovered in the remainder of England; though in process of time many of the mines have been worked out.

The county has a romantic history. It suffered much from the vindictiveness of the Civil War, and numerous churches and houses—usually nests of Royalists—were despoiled. Nowadays much of the northern part has become a "dormitory" for people working in Manchester and Liverpool, and many beautiful villages have suffered from "improvers." Knutsford, the "Cranford" of Mrs. Gaskell's famous story, is in danger of becoming a satellite town of Manchester.

At Daresbury, "Lewis Carroll" (Charles Lutwidge Dodgson), the author of *Alice in Wonderland*, was born. Charles Kingsley, the author of *Westward Ho!*, was once a canon of Chester (see article), the ancient county town, where one may still walk on the Roman walls. This was the last city to withstand William the Conqueror; and when it fell, Britain was considered vanquished.

Chess. According to one tradition, chess was invented in India to divert men from the attractions of actual war by giving them warfare in miniature. In chess, two opposing forces—consisting on each side of the king and queen, two bishops, two knights, two rooks (or castles), and eight pawns (foot-soldiers)—are drawn up in battle array, and the strategy of the conflict lies in making a successful attack on the enemy's king. When one player or the other is unable to protect his king from capture on the next move, he is "checkmated," and the game is over.

In the hands of masters, chess becomes one of the most intricate and interesting games ever invented, yet a child of 7 or 8 can understand the moves and play a simple game. Its value as mental training has often been urged, and some experts have developed such ability that they can



CHESS-BOARD SET FOR PLAY

On both back rows, from left to right, are Rook (Castle), Knight, Bishop, Queen, King, Bishop, Knight, Rook. The Pawns occupy the front rows. The board is so placed that each player has a white square at his right hand.

play as many as fifty games at the same time, sometimes with the additional handicap of being blindfolded. This is an astonishing feat of memory, the expert being merely told the moves by a system that gives a name to every square on the board.

The great masters of chess are, and always have been, international figures. The game was much developed by the 16th-century Spaniard, Ruy Lopez, but it was only during the 19th century that it became widespread and popular. An Englishman, Staunton, was the first of the modern champions ; he was followed by an American, Morphy ; two Germans, Steinitz and Lasker (the latter was world champion for 27 years) ; a Cuban, Capablanca ; a Russian, Alekhine ; a Dutchman, Euwe ; and the Russian experts, Botvinnik, Bronstein, and Smyslov.

In Russia chess is the national pastime and everyone is taught the game from early childhood. In Great Britain annual championships for both adults and young people are held, most schools have a chess club, and chess-boards are standard equipment at all social clubs. Games are often played by post, and have been played by radio. Chess problems are a popular feature in many newspapers and magazines.

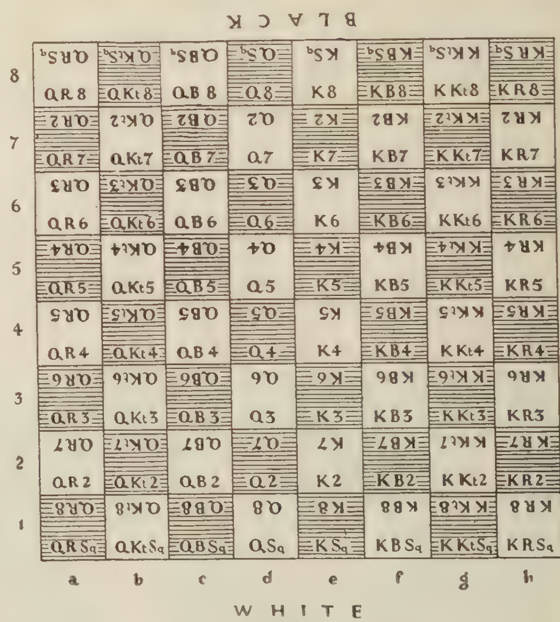
Chess is probably the most ancient of all games of pure skill. A chess-board and men have been found in Egypt which are at least 6,000 years old. The origin of the game is unknown, but it was invented somewhere in the Far East, passing from India to Persia, and thence to Europe. The word chess is supposed to be derived from *shah*, the Persian word for king, and checkmate from *shah mat*, " the king is dead."

The chess-board is divided into 64 alternating black (or red) and white squares, and the board is so placed that each player sits with a white square at his right hand. In setting up the pieces, the rule is always to " give the queen her colour," that is, always place the white queen on the proper white square and the black queen on the proper black (or red) square.

On the left is shown the position of the pieces and pawns on the chess-board at the beginning of a game. The pieces next to the king are called king's bishop (KB), king's knight (KKt), and king's rook (KR) or castle ; while those next to the queen are known as the queen's pieces ; for example, queen's bishop (QB). The pawns are arranged in front.

A pawn moves one square ahead, except on the first move, when it may be advanced two squares. Pawns cannot move backwards. In making a capture, however, the pawn moves diagonally and occupies the square of the captured man. If a pawn which has not left the pawn row attempts to move two squares ahead, when such a move places it beside an opposing pawn, the opposing pawn may take the first pawn *en passant*, just as if the latter had only moved one square ahead.

A bishop moves diagonally in any direction and for any distance so long as it keeps to the square of its own colour. The knight leaps over one square either forwards, backwards, or sideways, on to a square diagonally adjacent to that over which it has jumped. The knight alone can accomplish its move by jumping over any men that happen to be in the way, provided the move can be completed on to a vacant square, or on to one occupied by an opposing man, in which case the knight captures it. " Jumping " does not involve the capture of the intervening pieces, as in draughts. The rook, or castle, moves backwards, forwards, or sideways in a straight line any distance so long as the path is open. The

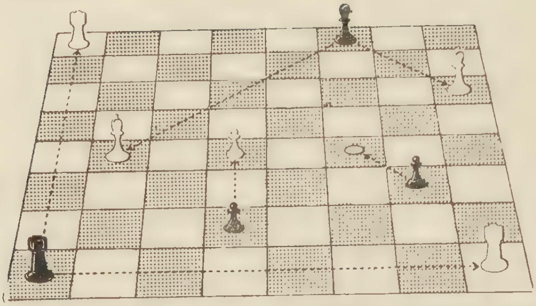


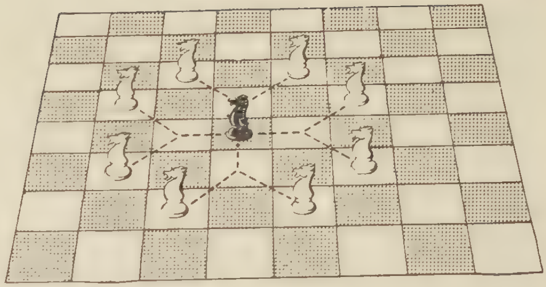
NAMING THE SQUARES

The English system of notation names the files from the pieces occupying their end squares at the start of play, and numbers the ranks 1–8 from the points of view, of both players. In the Continental or Algebraic system the board is seen from White's position, the files being lettered a–h and the ranks numbered 1–8. The same square is White's K Kt 3, Black's K Kt 6, and also g3.

NOT NECESSARILY AN OLD MAN'S GAME

Although only 12 years old, this girl had already taken part with a certain measure of success in the British Girls' Chess Championship. Children of 8 can learn the moves of the game, but they may still be learning something new when they are 80. Many British secondary and public schools have chess clubs, and the pupils not only arrange matches among themselves, but also play against the staff. Chess is the national game of the Soviet Union.





SOME OF THE PRINCIPAL MOVES IN CHESS

Diagram on the left : the Rook or Castle moves either perpendicularly or straight across the board, and the Bishop travels diagonally in any direction. The Pawn moves one square at a time straight forward, except that it may move two squares on its first move, and it "takes" diagonally. Diagram on the right : the Knight leaps over any of the four adjacent squares to a square lying diagonally next to it, ignoring any piece on the "jumped" square.

queen is the most valuable of all the pieces ; it can move vertically, horizontally, or diagonally, and for any distance. The king can move in any direction, but to the extent of only one square. The capture of an opposing piece is made by moving into the square that it occupies, and all captured pieces are removed from the board.

A player may once in a game perform the double move known as castling with the king and either rook when his king row is open on either side between the king and the rook. The king is moved two squares towards the corner occupied by the rook, and the rook is brought one square nearer than the king to the middle of the board. This cannot be done if any piece stands between the king and the rook ; or if either of these pieces has previously been moved ; or if the king is in check ; or if any opposing piece is attacking one of the intervening squares. A pawn which reaches the king row of the opposing side becomes a queen, or any other piece its owner may choose.

To "check" the opposite player is to manoeuvre one piece or several pieces so that the enemy king is in danger of capture on the next move. Each time a king is thus threatened, the fact must be announced by the word "check." If a player is in check and cannot extricate his king or capture the attacking man or place some piece in front of the king as a protection, he is "checkmated." The king is never actually captured, and may never be moved into check. A "stalemate" occurs when a player, though not in check, cannot move any of his pieces ; more specifically, when he cannot move without bringing his king into check. This is a draw. A game is also a draw when neither player has sufficient men left on the board to checkmate the other. "Perpetual check" (also a draw) occurs when a player who cannot hope for checkmate is yet able to check his opponent's king, move after move, with absolutely no possibility of escape.

Chester. The county town of Cheshire stands on the river Dee some seven miles from its estuary, and was once an important port. From here sailed the poet Milton's friend, Edward King, commemorated in "Lycidas" (1637), on the voyage to Ireland on which he was drowned. Chester now forms the gateway to North Wales by both

"LIVING" CHESS CONTEST AT MAROSTICA

Two noblemen of Marostica, Italy, fought a chess duel some 400 years ago for the hand of the governor's daughter, and men took the places of the pieces. Here the descendants of the original "pieces" are taking part in the game, making the same moves as those of 400 years ago. The contest is held every year.

rail and road. The cathedral formerly the church of the Abbey of St. Werburgh, is of many styles of architecture, from Norman to Late Perpendicular, and has a tower 127 feet high. Of the castle only Caesar's Tower remains. But the old walls survive, and the visitor can walk around them for a distance of about two miles, coming down by steps to the road at occasional gaps.

Among the most interesting features of Chester are the Rows, which are open paved galleries in front of the first floors of the buildings in the four main streets which converge on the market-place. The houses are in the half-timbered style of the 16th and 17th centuries. Shops line the Rows, which are reached from the streets by steps. Stanley Palace, which is a beautiful example of Tudor architecture built in 1591, was presented to the city by the Earl of Derby in 1928. Chester races are held annually on the Roodee, the only circular racecourse in Great Britain. Chester is noted for its cheese markets, and has engineering, brewing, and other industries. Above all, because of its beauty and the Dee rowing, it is a playground for Manchester, Liverpool, and Birkenhead. The population at the census of 1951 was 48,229.

J. Allan Cash

FINE OLD BUILDINGS IN THE ROWS, CHESTER

One of Chester's most attractive features are the Rows, paved galleries running along the first floors of the buildings in the four main streets. Many of the houses are in the delightful half-timbered style of the 16th and 17th centuries.

Chester was known to the Romans as *Deva Castra* (Camp upon the Dee) or simply *Deva*. Ethelfrith, King of Northumbria, captured and destroyed it early in the 7th century; and for a time it resisted capture by William the Conqueror, being the last place in England to fall to him. In 1255 it was almost destroyed by the Welsh prince Llewelyn, and nearly 400 years later, during the Civil War, it withstood a three years' siege by the soldiers of Cromwell, to whom it finally surrendered through lack of food in 1646. Chester has been a bishop's see since 1541, in Henry VIII's day.

Chesterton, Gilbert Keith (1874–1936). When G. K. Chesterton's mother visited his school, St. Paul's, to ask the High Master's advice about her son's future, she was told: "Six foot of genius. Cherish him, Mrs. Chesterton, cherish him."

G. K. CHESTERTON

Established as a literary figure on the strength of his first book—*The White Knight*—Chesterton wrote criticisms, poetry, essays, and fantastic fiction.

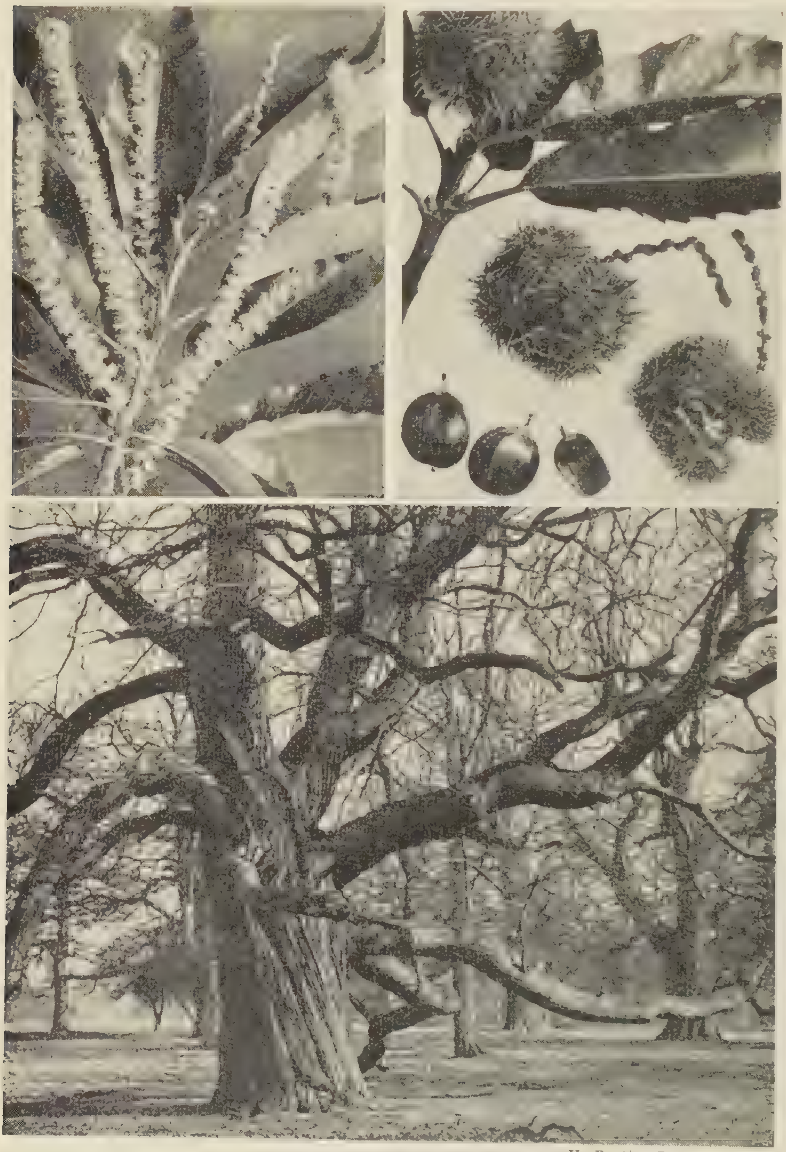
Chesterton might have made his name as a pictorial artist, but turned to literature and excelled in almost every branch. Beginning as a journalist, he became essayist, short-story writer, novelist, serious and comic poet, and the creator of "Father Brown," the well-known priest-detective. What he said of St. Thomas was true of himself: he had "that instantaneous presence of mind which alone deserves the name of wit." He loved to exercise this talent in debate, and almost anything could be a starting-point for a train of his most penetrating thought and his most brilliant wit. Once invited to lecture on "anything, from an elephant to an umbrella," he willingly and charmingly lectured—on the umbrella.

He loved to argue but never quarrelled; he once explained that his chief objection to a quarrel was that it interrupted an argument. Two of his best friends, George Bernard Shaw and H. G. Wells, held fundamentally different views from his

own, but except for "an occasional explosion" from Wells, nothing marred the serenity of their association. Chesterton's identity of opinion with his great friend Hilaire Belloc caused Shaw to nickname them "The Chesterbelloc."

Chesterton was a perplexing mixture of intense seriousness and rollicking gaiety; he loved the world of romance and fantasy, constantly alleging it to be more sane than sanity. Because he liked emphasising the forgotten side of a truth he has been called a "master of paradox." When others considered orthodox beliefs dull, Chesterton found them "perilous and exciting" and defended conventionality in a most unconventional manner. In 1922 he joined the Roman Catholic Church.

Chesterton hated smugness, all that was drab and solemn and pompous. *The Napoleon of Notting Hill* (1904), one of his best-known works, is a story of civil war between the suburbs of London, resulting in the revival of pageantry. He loved gaiety in living and jokes about everything, even his own immense size. Towards the end of his life he excelled as a broadcaster, and more of the "ordinary people" whom he loved (and considered most extraordinary) were given a glimpse of that personality which, as much as his literary achievements, caused Mgr. Ronald Knox (another Roman Catholic wit and scholar) to say: "Almost anybody was an ordinary person, compared with him."



H. Bastin; R. A. Malby

SWEET CHESTNUT TREE IN DETAIL

The characteristic furrows in the grey bark, which in older trees run spirally near the base of the bole, are easily distinguishable. The yellow catkins (top left) consist mainly of male, pale yellow flowers, and appear in June. The spiny coverings (top right) split open in October to release the ripe chestnuts.

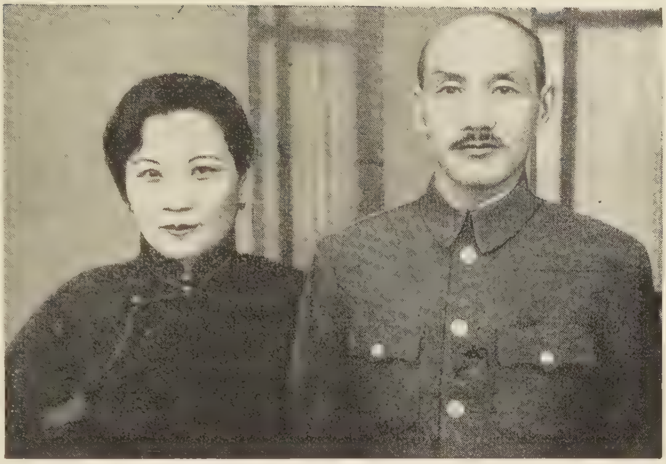
Chestnut. There are some five species of the true chestnut in Europe, northern Africa, Asia, and the temperate regions of America, all belonging to the group of trees which includes the oak, the beech, and the birch. You may know the common sweet or Spanish chestnut, *Castanea sativa*, by its large, lance-shaped leaves with their glossy surface and sharp points, and by the deep furrows of its grey bark, which in older trees run spirally near the root.

It flowers in June. The male flowers are pale greenish yellow and arranged in catkins about six inches long, which grow erect and are very conspicuous. The female flowers are small spiky tufts which sometimes grow separately and sometimes at the foot of the male catkins. They are arranged three together in a little cup, and when they are fertilised this cup becomes much enlarged and encloses them, so forming the spiny covering of the young nuts. In October the covering splits and allows the ripe nuts to escape. In England the nuts ripen only in the southern counties, but the chestnut is grown extensively in Spain and Italy for food, the nuts being used as vegetables and, when ground, as flour. Chestnuts boiled until soft, peeled, and re-boiled in syrup, form the delicious "marrons glacés" so well known in France. The wood is used for fences, and in Kent many of the hop poles are cut from chestnut boughs. The timber is but little sought after, as it is frequently found to be cracked. This tree

should not be confused with the horse-chestnut (see article) which belongs to quite another family.

Chiang Kai-shek (b. 1887). A united democratic China, free from foreign domination, was the lifelong dream of Chiang Kai-shek (pron. chang′ kī′ shek′). While serving as premier and president of the Chinese Republic and generalissimo of the armed forces, General Chiang strove untiringly towards that object.

Born of humble parents in the village of Wuling, in Chekiang province, he was sent in 1906 to Paoting military academy, and a year later he left to study soldiering in Japan. There he met the Chinese revolutionary Sun Yat-Sen and became his most devoted disciple. In 1911 Chiang took part in the revolution that set up the Chinese Republic. Between 1913 and 1923 he was out of favour with the reactionaries who had seized power; then, in 1923, he was sent by Dr. Sun to study military science and revolutionary tactics in Moscow. On his return Chiang founded a military academy at Canton, the southern stronghold of the revolutionaries.



CHIANG KAI-SHEK AND HIS WIFE

Great soldier and administrator, General Chiang Kai-shek, leader of the Nationalist government, embodied the spirit of Chinese resistance during the eight years of war with Japan. His wife also worked untiringly at home and abroad for her country and her compatriots.

After Sun's death in 1925 Chiang rose to power in the Kuomintang (Chinese Nationalist party), and in 1926 he took command of the Nationalist army. He led his forces against the war-lords who had divided North China, at the same time breaking with the Communists. In 1927 he established a central government in Nanking. In that year, too, he married Soong Mei-ling, a Christian Chinese who had been educated in the United States, graduating at Wellesley College.

In 1928 General Chiang continued his drive towards the north, and in June he entered Peking and became president of the Chinese Republic. But the country was still divided owing to Communist resistance, and when the Japanese invaded Manchuria, General Chiang was unable to offer effective resistance. Though forced to resign the presidency, he continued as commander-in-chief of the army, and in 1933 signed peace with the Japanese. But he continued to try to unify and strengthen the country, and came to an agreement with the Communists. In 1935 he was again premier, and he and Mme. Chiang launched the New Life movement, a programme of self-help, education, and social progress.

With the outbreak of war against Japan in July 1937, China rallied to its generalissimo, and he proved an able leader. In 1942 (during the Second World War) he became commander of all Allied forces in China, and the next year became president once more. In November 1943 he went to Cairo for talks with President F. D. Roosevelt and Mr. Winston Churchill, Mme. Chiang acting as his interpreter. With the end of the Second World War in 1945 his dream of an independent, united China was again shattered, for conflict broke out anew with the Communists, who at last swept on almost without check. In 1949 Chiang resigned the office of president of the hard-pressed Nationalist government and set up headquarters in Formosa, which, with its troops and air and naval bases, was to be the chief centre of Nationalist resistance against the forces of the Communist government, headed by Moscow-trained Mao Tse-tung, on the mainland. (*See* CHINA.)

Chicago, UNITED STATES. In 1830 Chicago was a cluster of log cabins in the midst of a marsh, huddled for protection close to the stockade of Fort Dearborn, in what is now the state of Illinois, near the southern end of Lake Michigan. It is the world's greatest railway centre, the terminus of nearly 40 lines, whose combined mileage is half that of the whole railway system of the United States. It is also the world's greatest livestock market and meat-packing centre, handling about a quarter of the entire meat output of the country. As well as this, it is one of the most important grain markets of the world, and ranks high among the steel producing areas of the United States. The population of the city in 1950 was 3,620,962.

Chicago is one of North America's great ports, even though the narrow Chicago River has lost some of its former importance, for the Calumet harbour at the south end of the city handles enormous shipments, chiefly for the iron and steel industry. Seventy per cent. of the United States supply of hides is used or distributed in the Chicago district; and this same district handles more lumber, makes more machinery, and builds more railway carriages than any other place on earth. It is the centre of the agricultural implement industry, which has revolutionised farming methods everywhere. From Chicago are distributed foodstuffs, drapery, clothing, pianos, and household requisites, as well as an immense quantity of general merchandise of all kinds.

Chicago has many fine public buildings. The Chicago Museum of Natural History, overlooking Lake Michigan, is possibly the greatest of its kind, and near it is the Shedd Aquarium. Skyscrapers include the Civic Opera House, the Wrigley building, the Board of Trade building, the Masonic

BUSINESS HEART OF THE CITY AND PORT OF CHICAGO

The metropolis of the Middle West, Chicago is situated on the Chicago River, near the southern end of Lake Michigan. The centre of the livestock, meat-packing, and grain industries, the city is also one of North America's principal ports, handling ore for the iron and steel industries. Chicago is also a very important centre of scholarship.

Temple, and those erected for the *Chicago Tribune* and *Chicago Daily News.* On the Palmolive Building, 600 feet above Michigan Avenue, is a revolving beacon of more than two thousand million candle-power, erected for the guidance of air pilots and visible for over 100 miles. Soldiers' Field is a stadium that will hold 125,000 people, and the city is remarkable for the extent of its public parks and the size of its libraries.

Chicago is one of the most important centres of learning in the United States. Chicago University, founded in 1891 and endowed by John D. Rockefeller senior and other private benefactors, ranks high in importance, and is housed in fine granite buildings. Chicago also boasts the College of Physicians and Surgeons, the Illinois Institute of Technology, the Art Institute, departments of the North Western, Illinois, De Paul, and Loyola Universities, the John Marshall Law School, and several medical and theological colleges.

Its history began when a San Domingo coloured man built a hut on the Chicago river in 1777. In 1804 John Kinzie, the first white settler, bought the hut and conducted from it his trading with the Indians. The same year the United States built a stockade near by, known as Fort Dearborn. In 1812, during the war with Great Britain, General Hull, who was in command of the British forces at Detroit, ordered the fort to be evacuated. The little body of settlers set out with their women and children round the foot of the lake, but before they had gone more than three miles they were attacked by a band of Red Indians and all were taken prisoner or killed in the fight. After the war the settlement was soon rebuilt. By 1837 the population had mounted past the 4,000 mark. The commercial importance of the city was assured in 1848, when the Illinois and Michigan Canal was built, making an all-water route from the Mississippi through the Great Lakes to the north-east. But it was the building there of the great trunk railways to east-coast cities which ensured Chicago's pre-eminence as the metropolis of the Middle West.

The land on which Chicago stands was so marshy as to be unhealthy, and in the 19th century the level of the whole city was raised between 12 and 14 feet. On October 8, 1871, came a great, disastrous fire. It began in a barn in De Koven Street, and is said to have been started by an overturned oil-lamp that fell into some straw. Three-and-a-quarter square miles, including the entire business district, were devastated. In the 27 hours during which the fire raged, some 17,450 houses and blocks of flats were destroyed, also 1,600 shops, 60 factories, 28

hotels and public buildings. At least 250 lives were lost, and damage amounted to approximately £40,000,000. Rebuilding was begun almost before the embers had cooled, and was completed within two years. In the business section of the city, congestion soon became so great that Chicago architects devised the first steel-framed skyscrapers in order to overcome the shortage of ground-space.

In the decade after the First World War, Chicago became notorious the world over for its gangsters, who defied all laws and outraged public morality in their dealings in contraband liquor, the sale of which had been banned throughout the United States from 1920. These gangs, composed almost entirely of men wanted by the police for murder, caused a reign of terror in the city for a decade. Al Capone and Big Jim Colosimo were two of the most notorious. But the various rival gangs fought one another as keenly as they fought the police and so reduced one another's strength. Then prohibition was repealed in 1933 and the chief cause of gangsterism was removed. Finally Chicago was determinedly cleaned up in 1931 to 1934 by Mayor G. E. Q. Johnson, Capone being sentenced to 10 years' imprisonment in 1931 for an income-tax offence.

Chicago has always been notorious, too, for its "isolationism," which was strong between the two World Wars. These views found a mouthpiece in the *Chicago Tribune*, a paper violently hostile to Britain, Germany, and Russia, and also in the "America First" movement, many of whose leaders were Chicago men. But after the treacherous Japanese bombing of Pearl Harbour (December 7, 1941) no place was more patriotic or supported the war with more enthusiasm. Yet after the war Chicago became as isolationist as it was before, its great distance from any ocean rendering it apparently secure from hostile attack. A large proportion of its population are people who have never even seen the open sea.

Chichester. When the Romans came to Britain they discovered, on a plain between the South Downs and the sea, a tribal city of strategic importance, which they called Regnum. In the 5th century A.D. the Saxons overran this region, established the kingdom of the South Saxons (Sussex), and called the city Cissa Ceaster, after their king Cissa, whence comes the present name of Chichester. As it now exists, this English cathedral city is of essentially Roman planning, with its two main streets crossing at the centre—marked by a fine old market cross.

The cathedral itself was erected on the foundations of Roman buildings, and remains of these, and of mosaic pavements, have been found within the massive city walls, which are also of Roman origin. Stane Street, the great Roman road to London, which is 63 miles away, starts in the city. The building of Chichester cathedral extended over several centuries, and all styles of architecture from Norman to Tudor times can be found in the walls, roofs, and arches. The detached Perpendicular bell tower, or campanile, is the only one of its kind in the country.

Chichester to-day is mainly a residential town and an agricultural centre, with tanning, woollen, and brewing industries. It is within a few miles of the seaside villages on Selsey Bill; and Chichester Harbour, two miles from the city, is a shallow inlet with old-world villages frequented by yachtsmen and fishermen. The population in 1951 was 19,110. Goodwood, near by on the South Downs, is well-known for its horse-racing and motor-racing. It has the most picturesquely-sited racecourse in England, and the meeting in July is a fashionable occasion in a gracious natural setting.

The poet William Collins (1721–59) was a native of this town.

MARKET CROSS AND CATHEDRAL IN CHICHESTER

At the junction of the four main streets in Chichester, county town of West Sussex, is the ornate Market Cross, which was erected about 1500 and is somewhat marred by the belfry added in 1724. Behind and to the right of the Market Cross is the spire (277 feet) of the cathedral, which replaced one that collapsed in 1861. It is visible from ships in the Channel.

CHILDREN, YESTERDAY *and* TO-DAY

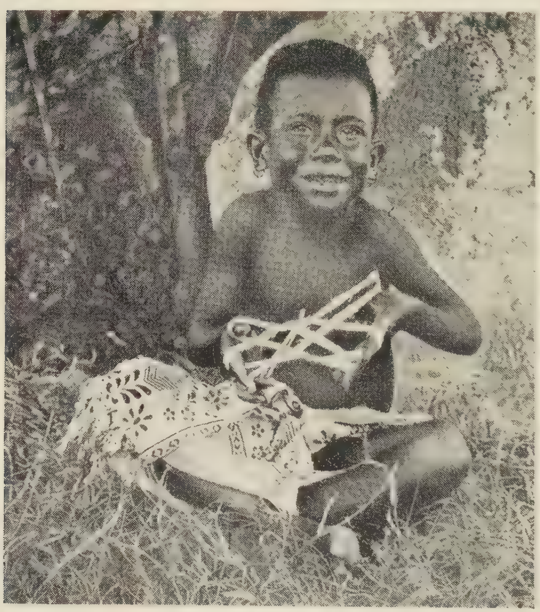
Children. It is generally claimed, by those who are no longer children, that childhood is a happy state. A quick glance over the course of history reveals that the nature of children has changed very little. It is known, among other things, that Demosthenes, the great orator and statesman of ancient Greece, was tormented by nicknames when he went to school; Roman boys span tops, played "ducks and drakes" with shells on the seashore, and baited their schoolmasters; while a medieval rhyme runs:

> I would my master were a hare,
> And all his bookes houndes were,
> And I myself a jolly hunter,
> To blow my horn I would not spare!

In what is said to be the oldest English schoolbook, a series of dialogues attributed to Aelfric, a cleric of Canute's time, a schoolboy, on being asked whether his friends have behaved well that day, retorts: "That you must not ask; I dare not tell on them."

The little Hans Butzbach, a 15th-century German child, was given figs, raisins, almonds, and cakes, to make him pay attention to his first lessons. And Erasmus, the great Renaissance scholar, describes a school half-holiday on which, besides playing games, boys hunt for crickets, frogs, and butterflies, and experiment with different kinds of bait for their fishing tackle.

Girls had quieter pursuits. The remains of their dolls (not always despised by boys) have been found in Egyptian, Greek, Roman, and aboriginal American excavations. Sisters were usually educated at home or else not at all, for in many countries they were considered the inferior rather than the gentler sex. But one may guess that there were always high-spirited, intelligent girls, who followed their brothers into scrapes, and even surpassed them at lessons when they had the chance. Madame de Genlis, governess to the children of the Duc de Chartres, did not discriminate between the three boys and the girl, and insisted that they should all be equally athletic, so that even the 12-year-old French princess could do her three miles at a run! Charles Lamb recalls a "writing-school" where boys in the morning and girls in the evening were taught by a deformed youth, who finally ran away in despair because he found the girls such a "handful."



FUN WITH STRING IN PAPUA

Cat's cradle is played by children in almost every country. This boy lives close by the river Fly in Papua, on the island of New Guinea, where the people are among the most savage in the world; but he manipulates his piece of string in the same way as civilized children do.

Upbringing of Girls

Scotland and America took the lead in offering girls the same teaching as boys; but tradition dies hard, and not until the middle of the 19th century did there arise anything like a country-wide demand in the United Kingdom for giving girls as thorough an education as their brothers. Up to then and even afterwards there were establishments for girls, who were judged to be better for not knowing much beyond housewifely matters and being able to read the Bible. Higher in the social scale they were taught punctilious manners, wore iron collars and "backboards" to make them sit up straight, and were advised to repeat "prunes and prisms" to improve the shape of their mouths. They might also learn to play "an instrument" or do a little sketching and embroidery, but it was held to be unfeminine to do anything brilliantly.

Eventually progress freed them to do gymnastic exercises and play hockey, produce essays instead of samplers, "drop" music if they had no taste for it, talk slang, bring out school magazines, and pass examinations. In short, the modern schoolgirl emerged, with all her faults probably a happier and certainly a healthier girl than her forebears.

No such great revolution has occurred in the education of boys, but the same is undoubtedly true of them. Although it has been said that grown-ups claim that childhood is a happy state, and the nature of children has changed very little, childhood was regarded up to the 18th century and even afterwards as something to be left behind as quickly as possible. To be grown up was preferable to being a child, however happy. This general opinion was probably the reason for our ancestors' early marriages and the fact that in most old pictures children are dressed in smaller versions of adult clothes.

Fears and anxieties certainly surrounded infancy and childhood in the days when pediatrics (the study of children's diseases) was yet unknown. The death-rate among children was high. And in these days, when everyone knows the necessity of light clothing and fresh air for babies, it is horrifying to hear of their being "swaddled" like Egyptian mummies, only their faces being left

[Continued on page 373

B. T. Prideaux

In China, trousers are worn by women almost as much as by men, and this grandmother, dressed in coat and trousers and holding her grandson, certainly has a grandfatherly appearance. The birth of a son is an occasion for much rejoicing in a Chinese household, because only a son can perform the rites of ancestor worship. Chinese children under the age of eight are rarely punished.

GIRL OF PAKISTAN DISPLAYS HER DOWRY

Sitting with dignified composure to have her photograph taken, this girl is the daughter of a wealthy Mahomedan merchant of Pakistan. In the sub-continent of India it is customary among rich people to bedeck their daughters with masses of jewelry so that match-makers can assess the value of the property that will be received by the husband at marriage. Muslims, especially those living in cities, do not now object to posing for the camera. Originally, their objection was based on a belief that the camera might do them some harm, not on their religion, as is often thought.

IN INDO-CHINA THEY GROW UP EARLY

These two girls, dressed in tribal costume, are Stiengs, a backward people living in the hills in remote regions of South Vietnam, a republic of south-east Asia. The Stiengs, owing to lack of communications, have been little influenced by Western civilization, and the childhood days of these girls probably ended before they were ten years old. According to Western ideas they marry at a very early age, and are old women at 35, when they have become household drudges.

CHILD AND PARENTS OF THE SEA DYAKS

Dr. Charles Hose

For centuries the Sea Dyaks of the island of Borneo were head-hunters, and this warrior still has his sword decorated with a scalp lock. His small son belongs to a generation who will grow up to regard such a barbarous practice as no more than a strange survival from the bad old days of long ago. The mother is wearing a curious corselet made of rattan cane, and a silver belt similar to her husband's.

AN AIRING FOR JAPANESE BABIES

Walter Weston

In Great Britain the baby of the family is usually taken for an airing in a perambulator, but in Japan an elder sister carries the baby slung on her back. The wooden shoes with high supports keep the wearers out of mud and snow in autumn and winter. They are kept on by a thong, which is gripped between the big and next toes something few non-Japanese can do without much practice.

D. McLeish

The son of a well-to-do trader of Biskra, Algeria, this young Arab wears the tasselled embroidered headdress, woollen cloak, long shirt-like garment, and leather shoes popular with the men of Algeria and Tunisia. Arabs wear a woollen cloak as a protection against the sun. He is probably enjoying a cup of very sweet tea, flavoured with mint. These Mahomedan people do not normally take any milk in either tea or coffee, of both of which they are extremely fond.

Algeria is inhabited by many peoples, and in addition to the Berbers, who are the original natives of the country, there are Arabs from the east, Negroes from the south, and half-breeds. These poor Negro children, whose parents might be the servants of the father of the lad on the opposite page, live in a hut of sun-dried mud in the Algerian Sahara, and probably work as goatherds with the village flocks. The leather bag contains a charm to bring good luck.

TWO SOLEMN YOUNGSTERS OF NIGERIA

Northcote Thomas

These two little girls of Nigeria, in West Africa, are wearing all their finery for a special occasion. The one on the right has ivory bracelets, and both are wearing anklets and garters of cowrie shells. Their headdresses and necklaces are of red and blue beads. They are not particularly happy about posing for their photograph, and appear to be looking at the photographer with grave suspicion.

The favourite plaything of this Beduin girl, seen here with her mother, is a doll, as it is with most girls everywhere. The Beduin are a nomadic people living mainly in the deserts of Iraq, Arabia, and North Africa, and such toys as their children do possess are very simple compared with those of Western families. Beduin girls do not go to school, but learn to help their mothers at an early age.

COLOURED GIRL IN U.S. COTTON-FIELD

A large proportion of the population of the southern states of the U.S.A. are Negroes, who are the descendants of slaves imported from West Africa to work in the cotton plantations. The slaves were emancipated after the American Civil War (1861–65), but many Negroes still work on the plantations. This girl is gathering the bolls, or ripe cotton pods. The Federal authorities are combating the discrimination against Negroes in some of the southern states.

This lad lives in Venezuela which, like most of the South American republics, has a rather mixed population. Most of the inhabitants are mestizos, people of mixed Spanish and Indian blood. There are some pure-blooded Indians, mostly in the Guiana Highlands and in the forests west of Lake Maracaibo. Despite the fact that elementary education is free and school attendance compulsory from the age of 7, nearly half the population are illiterate.

STURDY CHILDREN OF URI, SWITZERLAND

These three children look pictures of health and are an excellent advertisement for the clean mountain air of Switzerland. They speak German and live in Unterschächen, in Uri, the canton in which William Tell, the legendary Swiss hero, was born. The taller boy has strapped on his back a wooden carrier of the type used for taking loads up mountain-sides, and is wearing a jacket with a hood.

Horace Nicholls

The Dutch are a seafaring people, and in some families many generations have followed the sea, the youngsters inheriting a love of ships from their forebears. This boy is learning from his grandfather all about the rigging of a model sailing barge. Some of the older fishermen of Volendam, a village on the Ysselmeer, still sometimes wear the traditional lambskin cap, short jacket, and voluminous trousers. The Ysselmeer is a remnant of the former Zuider Zee, now mostly reclaimed.

ALL DRESSED UP FOR CHURCH IN HUNGARY

To many eyes the Sunday clothes, especially the boy's hat, of these Hungarian children may seem comic, but to them they are a source of great pride. The boy and girl live in the village of Mezokovesd, which is situated on the edge of the vast Hungarian plain, or Great Alfold. The women are noted for their needlework, and some of the brightly-coloured and embroidered garments are treasured as family heirlooms. Unfortunately, little of their fine work has been produced since the Second World War. Many of the children spend their time looking after flocks of geese.

HER FESTIVAL FINERY IS HOME-MADE

This attractive girl of Czechoslovakia, a Central European republic, may well be proud of her festival dress and kerchief, because she has done much of the work with her own hands. The girls living in country districts are taught the intricate and age-old embroidery patterns by their mothers, and at one time the dress of peasants of Czechoslovakia rivalled that of the Hungarians in colour and workmanship. Each region had its own particular costume that had been worn for centuries. In Czechoslovak schools Russian is the only foreign language taught within the official curriculum.

Larsen; Danish Legation

The five fair-haired little girls in the upper photograph are wearing the costumes of various Danish districts—something seen nowadays only on special occasions. The lower picture comes from Greenland, which is a province of Denmark, and shows Eskimo children. Their native clothing, brightened with embroidery and beadwork, makes the European dress worn by one or two look drab. There are some 24,000 Eskimos in Greenland.

exposed, and placed close to the fire in cradles made of solid wood and filled with feather pillows. It is amazing, not so much that so many children died as that so many survived.

But apart from half-smothering babies in this manner, not many instances of "coddling" appear throughout the generations to the present day. One thing parents dreaded sparing their children was the rod. Young Spartans were lashed until they bled, to teach them fortitude, and St. Augustine was first moved to prayer in order to ward off a whipping. In Russian convents the pupils used to be flogged all round once a week, and at Glastonbury Abbey, a noted school for "young gentlemen," a general whipping was administered before Christmas, perhaps to make the holidays more welcome! Tudor parents taught humility by making their offspring kiss the rod. Poor little Lady Jane Grey was tormented by "pinches, nips and bobs" from her parents, if she did not do everything "even so perfectly as God made the world" and she "thought herself in Hell" until it was time for her to go to her gentle schoolmaster, Mr. Ellam.

Humanity Gains Ground

But in the 18th century a more humane spirit began to creep in. It is true that some soft-hearted parents began to go to the other extreme and became dotingly indulgent. Writers of this period complain frequently of the naughtiness of their friends' spoilt children, and a letter from a father to his son at Eton does not order, but abjectly implores him, to get his hair cut :

"You gave me hopes that if I desired you would cut it. I will, dear Ste, be much obliged if you will."

Formality between parents and children was breaking down. "Papa" and "mamma" replaced "sir" and "madam" as a mode of address, and children began to be liked for their own sakes. Many more juvenile portraits were painted as the century advanced, and there are many stories of little boys and girls being allowed to eat and drink whatever and as much as they pleased, so that they sometimes fell senseless with intoxication!

The old belief in strictness did, of course, persist —strictness that would now be regarded as cruelty. Susanna Wesley was actually proud of herself because she taught her babies of a year old and even less to "fear the rod and cry softly," and she allowed them one day, at the age of five, to learn their letters. Even her son, the great preacher and founder of Methodism, disapproved of games for children, saying that a child who played when he was young would also play when he was a man.

But people had begun to feel an overdue sense of responsibility for the young, which gradually spread to all sections of society. It is true that "unimportant" girl babies were abandoned in China and rescued by missionaries, but it is also true that in 1739, not long ago by the standards of a "civilized" country, Captain Thomas Coram of the Merchant Service succeeded in building a Foundling Hospital for English children abandoned by poor parents. When we read of "child marriages" in the sub-continent of India, we may recall an 18th-century English bride of 13 who "cried for her dolls."

Until the industrial period the lives of poor children could be bearable and even happy. Families were large, and companionship rarely lacking. Towns were small, and by far the greater number of children lived in the country, a wilder and therefore more adventurous countryside than it is to-day. Poor children were made to work at far too early an age and bound by strict apprenticeships ; but the work was mostly healthy, either on farms or under the stern eye of a housekeeper.

But in the latter part of the 18th century there dawned a sadder era. The rapid industrialisation of England outpaced the making of laws to safeguard children. Cheap and plentiful labour was needed for the mines : children worked for 14 to 16 hours a day, living an underground life, hardly ever seeing the daylight except on Sundays. These were mainly the sons and daughters of miners, but orphans and pauper children were sent in waggon-loads to the new factories and mills in the North and Midlands of England. Little boys were forced to sweep chimneys, often urged upwards, when they were frightened, by pins or lighted straws applied to the soles of their feet. Until the conscience of the country was awakened there were no official protectors for orphans or for those whose parents were too poor to keep them safely at home. The country child might apply to the local squire ; for the child in a manufacturing area there was only an unfamiliar, perhaps callous, magistrate. The story of the early days of unregulated industry and child exploitation makes grim reading.

Happily, Parliament was eventually forced to attend to this terrible state of affairs, and whereas in the Middle Ages apprentices had had to work from dawn till dusk, laws were now passed that limited children's hours of work. In 1884, Benjamin Waugh founded the National Society for the Prevention of Cruelty to Children, and between 1889 and 1908 further statutes were passed which gave additional protection to youth.

The Children's Charter

In 1942, educationists of 19 nations met in London and prepared the "Children's Charter." This maintained :

1. We believe that the personality of the child is sacred and that the needs of the child must be the foundation of any good educational system.
2. The right of every child to proper food, clothing, and shelter shall be accepted as a first charge in the resources of the nation.
3. For every child there shall always be available medical attention and treatment.
4. All children shall have equal opportunity of access to the nation's stores of knowledge and wisdom.
5. Full-time school for every child.
6. Religious training shall be available for all children.

This Charter crystallised modern opinion on the care of the younger generation : the rights of adopted children were set out separately three years later. There is nothing new in the idea of adoption. It has been common in civilized countries from the time of ancient Babylon. What is new is the idea that adoption should benefit the child rather than that the child should add to the adopter's own prestige or comfort. A public inquiry, resulting from the death of a child placed in the care of "foster-parents," gave rise to the

TROLLEY-BOYS IN AN ENGLISH COAL MINE

The rapid industrialisation of England in the 19th century created a demand for cheap and plentiful labour in the coal mines, and children worked underground in almost complete darkness for from 14 to 16 hours a day. This print dates from 1842.

" Curtis report " (named after Dame Myra Curtis, the committee chairman) in 1945, which pointed out that adopted children should have " affection, understanding of defects, respect for personality, and self-esteem : stability : opportunity and a share in the common life of a small group of people."

And so the eternal procession of children continues : the African baby carried on his mother's back ; the European one in the pram ; the young Eskimo drinking cod-liver oil for a treat, and the young American eating his ice-cream at the " drug-store " ; the Basques and the Scots, with their strangely similar " gatherings " for games, and skirling bagpipes ; the Irish children, pleasantly frightened by tales of the " banshee," and the children of Chile, scared into goodness by talk of the " cuca," the mythical bogey ; the French schoolchildren breakfasting on rolls and coffee, and the young Russians putting butter and salt on their buckwheat porridge.

The little contrasts and similarities are endless, and if " circumstances alter cases," it should be remembered that custom really does little to alter children. All of them, though innocent, are barbarians at birth. They must learn discipline and wisdom and the right pursuit of happiness from their elders, who remember sadly, even when goaded to exasperation by the shortcomings or lack of manners of their sons and daughters, that youth is " the fault most quickly outgrown."

Children's Books. Every large bookshop nowadays has many special shelves crammed with books that have been specially written, illustrated, and published for the entertainment of boys and girls of all ages. They range from baby picture-books and simple alphabets, through collections of nursery rhymes and fairy tales, to stirring yarns of adventure and tales from history and the classics. The booksellers call them all " juveniles."

A hundred years ago you would never have seen such attractive rows and rows of " juveniles " in any shop, for comparatively few authors or publishers then bothered much about catering for children—except for producing school text-books, perhaps. As for the few children's books that did get published, it is doubtful if boys and girls of to-day would have had any patience with the general run of them.

Two hundred years ago there were hardly any proper children's books at all. Young people had to derive what amusements they could from the books of their parents. Sometimes they were lucky, especially if their parents had books like Defoe's *Robinson Crusoe* (1719) in the house.

Many old fairy stories, including those of Cinderella, Blue Beard, and Puss-in-Boots, had been collected and rewritten in 1697 by a French writer, Charles Perrault, and translated into English some 30 years later. This was the first English collection of such stories. *Grimm's Fairy-Tales*, collected by two scholarly German brothers, Jakob and Wilhelm Grimm, were first published in Germany in 1812. The stories of the third great writer of fairy tales and fantasies, Hans Andersen, a Danish author, did not begin to appear until 1835, but Andersen continued to write them a few at a time throughout the next 35 years. Other stories which became immediate nursery favourites were coloured with the magic of the fabulous East, like those of Aladdin, Sindbad, and Ali Baba ; they were taken from *The Arabian Nights' Entertainments*, of which the first English translation was published during 1838–40.

Such stories inspired many later writers to invent new worlds of magic and wonder. Charles Kingsley wrote *The Water-Babies* (1863) and Lewis Carroll (Charles L. Dodgson) gave the world the two immortal books, *Alice's Adventures in Wonderland* (1865) and *Through the Looking-Glass* (1871). The solemn John Ruskin wrote a rather solemn fairy story for children, *The King of the Golden River* (1851). Thackeray wrote a rollicking " pantomime " called *The Rose and the Ring* (1855). Washington Irving, an American author, produced the delightful *Rip Van Winkle* (1820), about the man who went to sleep for 20 years. Another great work of fantasy, *Gulliver's Travels*, by Jonathan Swift, had been published as early as 1726–27, but the author was certainly not writing for children. His book was intended as a bitter satire on the ways of men and women, and Swift would have been much astonished if he had foreseen that two hundred years later his stories about the strange lands of Lilliput and Brobdingnag would be enjoyed more by children than by adult readers.

A much later " immortal " (in more senses than one) was J. M. Barrie's Peter Pan, the boy who would not grow up. Peter first appeared in a book called *The Little White Bird* (1902), then in the famous play (1904), then in another book, *Peter and Wendy* (1912), which is the story of the play. Rudyard Kipling in *Puck of Pook's Hill* (1906) gave a background of fairy magic to some vivid tales of English history. Mention must also be made here of the exciting stories of " make-believe " adventure by Arthur Ransome, such as *Swallows and Amazons* (1930).

Closely allied to the fairy stories are those which depict that other world of fancy in which animals talk and behave like human beings. This notion

A FEW OLD FRIENDS FROM CHILDREN'S BOOKS

Here is a collection of old friends from the world of make-believe. Some, like Alice and Long John Silver, are easy to recognize. You will also probably be able to distinguish Mr. Toad ; Robinson Crusoe ; Tom, of *The Water-Babies* ; Winnie-the-Pooh ; Peter Pan, taking off from the house in the treetops ; Amyas Leigh, of *Westward Ho!* ; Meg, Jo, Beth, and Amy, of *Little Women* ; Peter Rabbit and Jemima Puddleduck ; Black Beauty ; Kipling's Mowgli ; and Tom Brown. Robin Jacques drew the pictures specially for this work.

is as old as *Aesop's Fables*, a collection which is much older than the Christian era. Another classic example is the old legend of *Reynard the Fox*, of which the most familiar version comes from Germany; but this, like *Gulliver's Travels*, was a satire intended for adult readers. From America in 1880 came *Uncle Remus*, by Joel Chandler Harris, with its quaint stories about Brer Rabbit and his enemy Brer Fox, based on Negro folk tales. Rudyard Kipling told the wonderful stories of Mowgli and his animal friends in *The Jungle Book* (1894), and had a great deal of fun with animals in his *Just-So Stories for Little Children* (1902). The small boys and girls in the earliest years of the 20th century were also the first to make the acquaintance of Peter Rabbit, Benjamin Bunny, Squirrel Nutkin, Tom Kitten, and Mrs. Tiggywinkle the hedgehog, in the highly original pocket-size picture books written and illustrated by Beatrix Potter (1866–1943). These have had many imitators. Kenneth Grahame, in *The Wind in the Willows* (1908), presented with peculiar charm the diverting adventures of Mole, Badger, Toad, and other animals of the English countryside. Hugh Lofting's many books about Dr. Doolittle have introduced animals in more fantastic guise. If you substitute talking toys for talking animals, A. A. Milne's *Winnie-the-Pooh* (1926) and *The House at Pooh Corner* (1928) also belong to this category.

Family Stories and Adventure Stories

There are other stories not fantastic, but concerned with the doings of ordinary children in the real world, usually the children of one particular family or household or group. This kind of children's story may be said to have begun with Maria Edgeworth's *Moral Tales for Young People* (1801); and for many years morals and religion were usually emphasised in such books, often at the expense of the interest and naturalness of the story. The first object of such books as Thomas Day's *Sandford and Merton* and Mrs. Sherwood's *The Fairchild Family* was to preach at children, not to entertain them. Some later writers contrived to do both, but present-day boys and girls find much that is priggish about most fiction for children written in the 19th century, even in such lively and amusing books as *Little Women* (1868) and its sequel, *Good Wives* (1871), by Louisa May Alcott, an American. Towards the end of that century the pleasantly sentimental stories of Charlotte M. Yonge (1823–1901), Mrs. Ewing (1841–85), Mrs. Molesworth (1839–1921), Mrs. L. T. Meade (d. 1914), and Rosa Nouchette Carey (1840–1909) were deservedly popular; but the real break with priggishness came with the stories of Edith Nesbit (1858–1924), whose Bastable family, in *The Story of the Treasure-Seekers*, *The Would-be-Goods*, and *New Treasure-Seekers* (all written at the turn of the century), consisted of very natural, naughty, and quite lovable children. From these books, and other more fanciful works by the same writer, such as *The Story of the Amulet* (1906), there are no moral lessons to be acquired, only a lot of delightful fun. Many authors now write convincingly *for* real children *about* real children, perhaps none more happily than Noel Streatfeild.

Boys (and many girls) may prefer stories of brave adventure, either in the present day or in the romantic past—stories of travel on sea and land and in the air, set in tropical forests, South Sea islands, barren deserts, or Arctic wastes; stories of peril among wild animals, savages, pirates, bushrangers, Red Indians; stories of battle and bravery. Among the "classics" in this kind are Charles Kingsley's *Westward Ho!* (1855) and R. L. Stevenson's *Treasure Island* (1882). There are also the grand sea yarns of Captain Frederick Marryat, such as *Peter Simple* (1834), *Mr. Midshipman Easy* (1836), and *Masterman Ready* (1841); and such exciting books as *The Scalp Hunters* (1851), by Thomas Mayne Reid, and those of the American, James Fenimore Cooper, including *The Last of the Mohicans* (1826), *The Pathfinder* (1840), and *The Deerslayer* (1841). Throughout the later decades of the 19th century a large group of famous writers catered regularly for a youthful public that was demanding more and more adventure; they produced two or three books annually for many years in succession. They were led by R. M. Ballantyne (1825–94), whose most famous story was *The Coral Island*, W. H. G. Kingston (1814–80), George Manville Fenn (1831–1909), and, not least, the fabulous G. A. Henty (1831–1902). Their books sometimes revealed that 19th-century preoccupation with moral or educational instruction. So did that early adventure story *The Swiss Family Robinson* (1813), written by a Swiss pastor, J. D. Wyss, in frank emulation of *Robinson Crusoe*. The French writer Jules Verne (1828–1905) should not be omitted from this survey, for he was the first author successfully to use in his stories the possibilities of modern scientific achievement, in such books as *Twenty Thousand Leagues Under the Sea* and *A Voyage to the Moon*. Notable among later masters of the adventure story were Percy F. Westerman, Max Pemberton, with *The Iron Pirate*, and the two men who collaborated for many years under the name of Herbert Strang.

Public School Life

From the time of *Tom Brown's School Days* (1857), by Thomas Hughes, stories of public school life have had a popularity among boys which only now shows signs of dying away. Thomas Hughes's famous story of Rugby School contained a generous proportion of "preaching," but nothing compared with what the Rev. F. W. Farrar put into his two school stories, *Eric, or Little by Little* (1858) and *St. Winifred's, or The World of School* (1862). It seems incredible that any boy should ever have waded through such books. Perhaps none did; but thousands of parents and uncles and aunts purchased them as presents. Talbot Baines Reed, in such books as *The Fifth Form at St. Dominic's* (1881), *The Master of the Shell* (1887), *The Cock House at Fellsgarth* (1891) and other robust, jolly school stories, showed that it was possible to convey many a helpful word of advice and warning about good and evil without being any the less entertaining. A more sophisticated type of school story was developed in the early 20th century by R. S. Warren Bell, P. G. Wodehouse, and others; and the tradition was maintained for many years, pre-eminently by Gunby Hadath, the first of whose many fine school stories was published in 1913.

Stories about girls' schools were never as firmly established in popular favour ; but among those who tackled them with success, Angela Brazil (d. 1947) will be remembered as outstanding.

Poetry for children also began by being edifying and instructive rather than enjoyable, if we are to judge from Dr. Watts's collection of *Divine and Moral Songs* (1713). Many of these are still quoted to-day—" How doth the little busy bee," for example, and " Let dogs delight to bark and bite." But the reaction against verses of this sort came earlier than the reaction against the "goody-goody " stories. By the middle of the 19th century, even though Charles Kingsley was writing " Be good, sweet maid, and let who will be clever," Watts's verses were being joyously parodied and burlesqued by Lewis Carroll in his Alice books, and no one objected. Probably the influence of the old nursery rhymes, which are so often just happy nonsense, was too strong. Carroll, in addition to parodying Watts, wrote much happy nonsense of his own, many of his verses (like " The Walrus and the Carpenter ") becoming almost as familiar as any nursery rhymes. But the nonsense verses of Edward Lear (1812–88), (*see* LIMERICKS), are now more appreciated by adults than by children. A famous book of nonsense rhymes originating in Germany was Heinrich Hoffmann's *Struwwelpeter* (1847), translated as *Shock-Headed Peter.* Hilaire Belloc's *Cautionary Tales* are hilarious parodies of the verses of the old moralists.

Verses combining delicate poetic fancy with profound understanding of a child's imagination were written by R. L. Stevenson in *A Child's Garden of Verses* (1884–86), and later by Walter de la Mare (1873–1956) in such collections as *Peacock Pie* and *Songs of Childhood ;* while A. A. Milne's verses in *When We Were Very Young* (1924) and *Now We Are Six* (1927) make up in whimsical humour for whatever they may lack in the way of poetic feeling.

There have also been innumerable special re-writings for children of the legends of ancient Greece and Rome, like Nathaniel Hawthorne's *Wonder Book for Boys and Girls* (1851) and *Tanglewood Tales* (1853), and Charles Kingsley's *The Heroes* (1856) ; books such as *Tales from Shakespeare* (1807), by Charles and Mary Lamb, which to modern eyes would seem to represent a very poor way of getting to know the greatest of poets.

A survey such as this could not to-day be called complete if it failed to mention the work of Enid Blyton (Mrs. Darrell Waters), who established herself after the end of the Second World War as the most prolific writer for children so far known, having tried her hand with considerable success at almost every conceivable kind of publication from comic strips to a life of Christ. In so doing she made her name a household word that is bound to be long remembered.

(*See also* articles on the principal collections and authors, *e.g.* ARABIAN NIGHTS ; ANDERSEN, HANS ; BARRIE, SIR J. M., etc.)

BETWEEN ANDES *and* PACIFIC

Chile (pron. chil'i). This is a most strangely shaped country stretching like a ribbon along more than half the Pacific coast of South America (*see* map with ARGENTINA, Vol. 1, p. 223). Every sort of climate is found somewhere in its length, from the rainless tropics of the northern part, through the mild, temperate central regions, to the bleak, rain-drenched archipelago of the extreme south, washed by the waters of the Antarctic sea. The snow-crowned peaks of the Andes (see article) are everywhere visible from the coast, rising in imposing array as a background. In Ojos del Salado and Mount Aconcagua they reach the greatest height in the Americas, rising to 23,000 feet.

Yet despite the variety of the country's aspects, despite its enormous length, and despite the sparseness of its population, the Chileans are a united and patriotic people. This national unity may be due to the fact that more than 70 per cent. of the population are collected in its temperate and fertile central regions. Except for the civil war of 1889–91, Chile has avoided the revolutions so frequent in other nations of South America.

In the north there are brown, parched deserts, rich in mineral treasures. In the south, Chilean Patagonia consists of a narrow strip of low forest mainland, fringed by hundreds of wooded islands, and terminating in the western part of the large and lonely group of islands known as Tierra del Fuego. Here the rainfall is almost incessant during the greater part of the year, and the land, which is rich in forests, fisheries, and grazing areas, is peopled only by Indians and a few solitary sheep-farmers, with here and there a trading post. Between these two inhospitable regions lies the heart of the country, a beautiful and fertile region consisting chiefly of a valley, about 700 miles long and 30 miles wide, between the low coast Cordillera (mountain range) and the lofty Cordillera of the Andes to the east. It is a region of perpetual spring, with one of the most delightful climates in the world. Rarely does the temperature fall below freezing point or rise above 77° F. In the north of this central region irrigation is necessary ; towards the south the rainfall increases. Here is the granary of Chile, where all cereals, vegetables, and fruits of the temperate zone grow to perfection. Low crosswise ridges of hills connect the coast mountains with the main range, dividing the long central valley into smaller valleys, with here and there swift

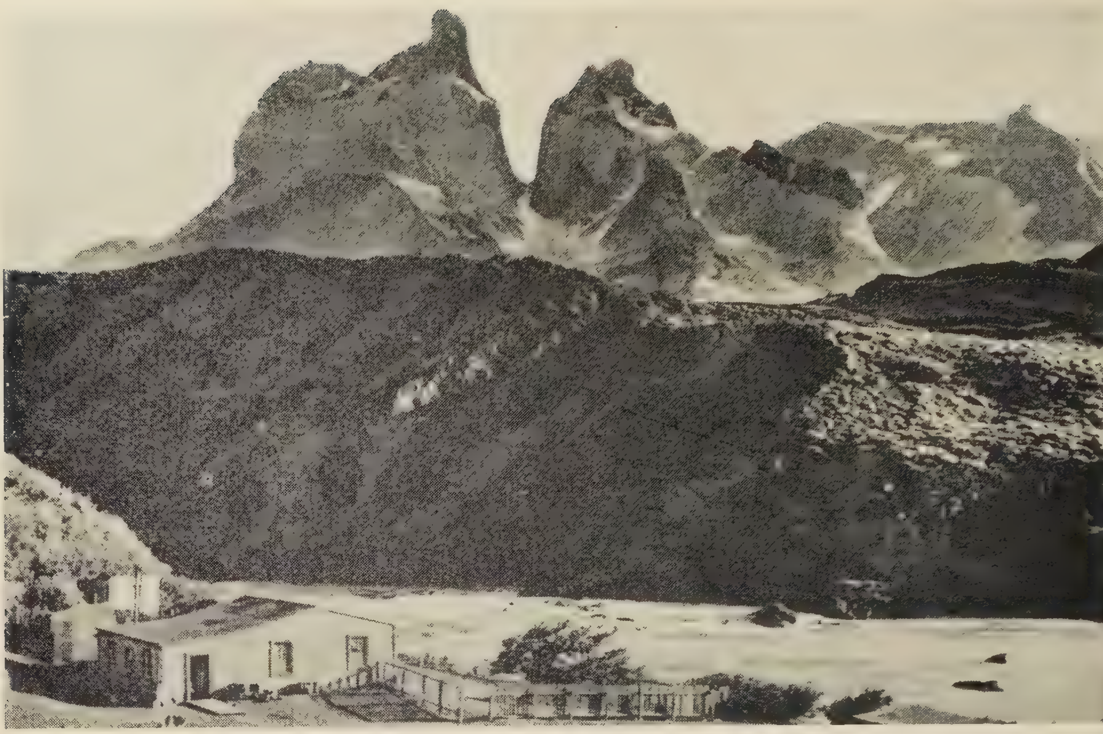
Extent.—Area 286,400 square miles ; coastline north to south 2,500 miles ; average breadth east to west 110 miles.

Population.—Census 1952 6,000,000 ; estimate 1955, 6,761,000.

Physical Features.—Andes extend along eastern frontier, making boundary with Bolivia and Argentina ; rise to 23,000 feet. Lower coastal range, with interior valley. Long Pacific seaboard.

Products.—Copper nitrate, iodine, iron ore ; wheat, wool, timber.

Principal Towns.—Santiago (capital, 1,350,409) ; Valparaiso (218,829) ; Concepción (120,099) ; Viña del Mar (85,821) ; Antofagasta (62,272) ; figures at 1952 census.



SHEEP-RANCHER'S HOME IN CHILEAN PATAGONIA

In the south, Chilean Patagonia consists of a narrow, forested strip on the mainland, fringed by hundreds of wooded islands, and terminating in the lonely archipelago of Tierra del Fuego. The rainfall is abundant throughout the year, and extensive grazing areas support huge flocks of sheep. Most of the wool is used by Chile's ever-expanding textile industry, but frozen meat and tallow are exported, for the most part to Great Britain.

torrents cutting their way to the sea. Wheat is the principal crop. Other important products are maize, alfalfa (lucerne: see article), potatoes, tobacco, sugar, rice, honey, wine, and cotton. Most of the land in this region is in large holdings. More than half of it, it is said, is in some five hundred huge estates, called *haciendas* or *fundos*.

THREE CHILEAN COWBOYS

The southern temperate region of Chile is well suited to cattle-breeding, and the Chilean cowboy is an even more colourful figure than his North American counterpart. The ponchos, or capes, are woven in red, blue, and yellow stripes.

The far south of Chile is little developed; but though the climate is very damp and cold, with its forests and green pastures it offers many prospects of useful exploitation. The soil is fertile; many areas are well adapted for grazing sheep, which in this cold climate grow thick fleeces of high quality.

Most of the wealth of Chile, however, has come from the Atacama Desert of the north, where rain falls only at intervals of many years. Here are the great nitrate beds, which owe their existence to the absence of rain. Sterile itself, the region fertilises much of the rest of the world, for the nitrate obtained by scraping the surface to a depth of a few feet is exported as a fertiliser in huge quantities to Europe, Asia, and the United States. Chile also supplies most of the world's iodine, which is produced as a by-product of nitrate.

Chile is rich in metals, being one of the world's greatest copper producers. Iron, coal, lead, silver, manganese, sulphur, gypsum, and various other minerals are found in profusion, most of them still awaiting exploitation. Oil was discovered in Tierra del Fuego in 1945, the wells producing more than the country's needs.

Two of Chile's island possessions are of exceptional interest. Four hundred miles west of Valparaiso lies Juan Fernandez Island, where

Alexander Selkirk lived in solitude for four years, inspiring Defoe's great romance, *Robinson Crusoe* (*see* CRUSOE, ROBINSON). Two thousand miles west of Chile is Easter Island (see article). Both these islands were declared national parks in 1935.

More than 5,000 miles of railway have been constructed, including a line running through most of the length of the country. The famous Trans-Andean railways are, in the surmounting of difficulty, perhaps the most astounding achievement of the railway engineer. One line links Valparaiso, Chile's greatest seaport, with Buenos Aires, capital of Argentina, and reduces the 11-day journey by boat through the Strait of Magellan to 40 hours overland. A second line, from Salta in Argentina to Antofagasta in Chile, was opened in 1948. There are many aeroplane services, both within Chile itself and running to places abroad.

The Chileans are the most enterprising and energetic of the peoples on the Pacific side of South America. Their long coastline, open to enemy attacks, has forced them to build a navy. Their army is one of the most efficient in South America, and there is an air force. Chile ranks with Brazil and Argentina as one of the three leading powers of the South American continent.

Most of the population of Chile are of European descent ; while a number are *mestizos* (of mixed Indian and European parentage). About a third of the working population is engaged in agriculture. There are government-controlled schools in all the towns, and education is free, and compulsory for children from 7 to 15 years of age.

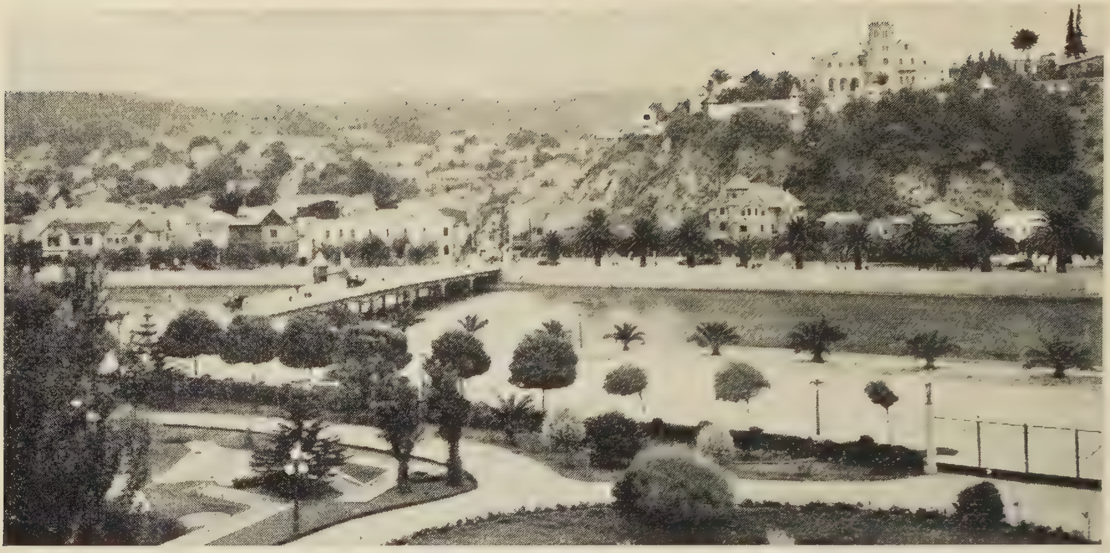
Civilization has as yet scarcely touched the Araucanian Indians, who live on the slopes of the central Andes. The Araucanians are the only original natives of the western hemisphere who were never conquered by any European invader. For centuries they successfully resisted the Spaniards, and it was not until 1881 that their nation, greatly reduced in numbers (there were fewer than 100,000 of them in 1950), recognized the authority of Chile. Araucanian influence is strong both in Chile's music and in its literature.

The Spanish conquest of what is now Chile was begun in 1535. Six years later was founded the city of Santiago, which has remained the capital ever since. Chile rose against Spanish rule in 1810,

Chilean Nitrate Producers' Association

CHILE'S VAST FERTILISER INDUSTRY

Four stages in the preparation of nitrate fertiliser, which is one of Chile's chief exports, are shown here. Drilling holes in the nitrate beds (1) for powder charges, which in exploding (2) blast out lumps of the raw material. Separated from sundry impurities, the nitrate is stacked (3) before passing to machines (4) in which it is dried out.



VIÑA DEL MAR, SEASIDE SUBURB OF VALPARAISO

Situated on the coast, about 5 miles south-east of Valparaiso, Viña del Mar is the residential suburb most favoured by well-to-do Chilean and foreign residents of that city. It has a population of some 70,000 ; and the only industrial installation of any importance is a sugar refinery. The climate is excellent, a cool south wind usually tempering the heat of the sun ; and the fertile soil produces a variety of fruit and vegetables, including melons, apricots, beans, and peas.

winning independence in 1818 under the leadership of Bernardo O'Higgins, who has remained the national hero of Chile. In 1866 Chile went to war with Spain as an ally of Peru, and Valparaiso suffered a good deal of damage from the guns of the Spanish fleet.

Boundary disputes with Bolivia again led to war in 1879. Peru came to the aid of Bolivia ; but Chile was overwhelmingly victorious and took from Bolivia her only strip of seaboard, and also deprived Peru of the rich nitrate district of Tarapacá and the provinces of Tacna and Arica. In 1929, after a long dispute, Chile ceded Tacna to Peru, but retained Arica and received the equivalent of £1,200,000 as purchase price.

The government of Chile is conducted by a president, who is assisted by a number of ministers of state and a national Congress. The president is elected for six years. The Congress consists of a Senate and a Chamber of Deputies, the members of both being elected by the votes of all citizens, both men and women, who are over 21 years of age and can read and write. The area of Chile (which comprises 25 provinces) is 286,400 square miles, and the estimated population in 1955 was 6,761,000.

Chimpanzee. A universal favourite in zoological gardens throughout the world is this member of the ape family, and not without good reason. For it is the most intelligent as well as the most easily tamed of all the apes, and it can be trained to do a wide variety of amusing and interesting things.

The scientist also is interested in the chimpanzee, which he knows by the name of *Anthropopithecus troglodytes* (man-ape of the caves), for there is much to be learnt from studying its general behaviour, especially as the chimpanzee has a mind closer to that of man than any other animal.

In its native haunts, the jungles of central and western equatorial Africa, this ape lives in family groups, roaming among the trees as well as on the ground. It is more active on the ground and a better climber than the gorilla ; it walks more or less upright, as do the other anthropoids, but usually takes some of its weight on the knuckles. Most chimpanzees have a pale and more or less hairless face, but hairiness and colour of face, like that of the rest of the body, vary with age and environment. The typical species is black-haired with a broad pinkish face, brown eyes, small nose, and protruding mobile lips. The arms are very long.

CHIMPANZEES UP TO THEIR TRICKS

The most intelligent of the ape family, chimpanzees if captured when young readily learn tricks, and seem to delight in imitating the actions of human beings. They live in the forests of central and western equatorial Africa. They are easily tamed.

ANCIENT CIVILIZATION *of the* FAR EAST

British Museum

CHINESE PAINTING DEPICTING A SCENE AT COURT

Part of a roll of silk 15 yards long, only a small portion of which is seen here, this picture was painted by Ch'in Ying, a court artist of the 17th century. It is entitled Springtime in the Palace of the Han (a dynasty which ruled China from 206 B.C. to A.D. 221) and shows court customs of the Ming period (1368–1644). This section depicts the reception of envoys. Owing to the perishable nature of paintings on silk, few works of earlier artists have survived.

China. A republic (until 1911 an empire) of eastern Asia, bounded on the east by the Pacific Ocean and its subdivisions called the Yellow Sea and the South China Sea, on the north by the Asiatic territories of the R.S.F.S.R., on the west by Soviet Turkestan, and on the south by Tibet, India, Burma, and Indo-China, China has an area of some 3,760,000 square miles and a population of some 600,000,000. Peking (see article) is the capital; other large cities are Nanking, Canton, Chungking, and Hankow.

A continent rather than a country in the usual sense of that word, China reaches to latitude 53° N. at the northernmost tip of Manchuria ; in the south the southernmost point of Hainan Island is only 18° from the equator. Between these two extremes all varieties of temperature are found, from severe cold (40° below zero) to great heat (120° in the shade). For the greater part of the year the temperature is about 80° Fahrenheit ; some parts of the territory have a short, severe winter, other parts have no cold weather at all. All kinds of fruits and plants are grown ; together with those familiar in British orchards (apples, plums, pears), oranges and bananas grow in one's own garden. Plucked from the tree while warm from the sun, these fruits have a flavour more spicy than those which have made a long sea journey ever possess.

The bamboo flourishes everywhere. This is the most useful of all the plentiful woods of China. It is used in making almost everything the Chinese need. Centuries before people wrote on silk and before paper was invented, the Chinese used to split the stems of the giant bamboo and shave them into thin wooden tablets. Scholars then wrote their essays on these, and when several tens of tablets had been covered with writing on both sides, holes would be pierced in one end of the tablets, and a leather thong would be passed through the holes and knotted. These were the first books of the Chinese, well over 3,000 years ago.

But that is only one of the many uses of bamboo ; other varieties make simple and cheap furniture, handles for the writing brushes, chopsticks

Extent.—Area (including Manchuria, Inner Mongolia, Sinkiang or Chinese Turkestan, and Tibet—all now claimed as part of China) about 3,760,000 square miles. Estimated population, 600,000,000.

Natural Features.—Himalayas (on borders of Tibet) rising to 29,000 ft.; Kunlun, Tien Shan, and Altai Mountains. Rivers: Yangtse, Hwang-ho, Sikiang, Peiho, and Amur. Gobi and Takla Makan Deserts.

Products.—Rice, wheat, barley, maize, millet, and other cereals ; soya beans, tea, silk, cotton, fruit ; pigs ; coal, iron, tin, and other minerals ; fish ; bamboo and camphor.

Chief Cities.—Peking (capital) nearly 3,000,000 ; Shanghai over 6,000,000 ; Tientsin 2,700,000 ; Shenyang (Mukden) 2,290,000 ; Wuhan, Chungking, Canton, Port Arthur-Dairen, Nanking (all over 1,000,000).

with which to eat, properties for theatre and musical shows, flower-vases (the knot forms a perfectly waterproof base for the vase), rice bowls, trays, pins or " wooden nails," and a myriad of other things. The tender shoots make a favourite vegetable.

There is an old Chinese story told of a man who, very poor in his youth and accustomed to all the cheapest things, became a great scholar and eventually was elected prime minister. A great friend of the Emperor, he remained unspoilt by all the luxuries of the Court. One day he was visited in his country home by the Emperor, who was surprised to find how simply and frugally he lived. All the furniture was of bamboo, even the minister's bed. " How is this ? " cried the Emperor. " Do I not pay my prime minister enough for him to live in far better style than this ? " " Sire," replied the minister, " it is not the money which is lacking ; it is the fact that from my birth I have seen about me my lord Bamboo until he has become a friend. Now, although my circumstances have changed, I still have an affection for that which carried my weight in infancy, which helped my fingers to write, which held my food and my drink, and to which I returned worn out at the end of the day. How could I live for a single day without this gentleman ? " From this story the phrase " this gentleman " has been a literary metaphor for bamboo for more than 1,600 years.

China has some of the most beautiful scenery in the world. In the west and south-west are great mountain chains (culminating in the Himalayas) ; in the north and north-west are great deserts, some of them several thousands of feet above sea-level. From these areas the land gradually slopes down towards the sea coast. Thus China has magnificent mountain scenery, forested hill slopes, river valleys and lakes, and wide areas where grow the tropical cactuses, orchids, and succulents, whose blossoms seem to set the desert on fire. Three great rivers form natural divisions : the northern provinces are cut off by the Yellow River or Hwang-ho ; through the centre of the land flows the great Yangtse river ; in the south the Sikiang, or West River, forms a natural waterway from the south-east coast into the far south-west nearly 2,000 miles away. In the west central part of China are the Yangtse gorges, with incredibly swift rapids and whirlpools, deep lakes, and cliffs hundreds of feet above the waters.

China is so old that the origins of her people are lost in the past. It is supposed from such evidence as has come down to us that the early Chinese were one of many tribes which inhabited the valley of the Yellow River about 5000 years B.C. These early Chinese developed a system of settled agriculture while the remaining tribes stayed as nomads, moving on from one place to another as their animals exhausted the grazing. About 4000 B.C. began the first city settlements ; these were surrounded by lofty, thick stone walls to keep out the wandering tribes. By 3000 B.C. the Chinese were making pottery vessels of elegant shape and with simple line decoration. Less than a thousand years later they had discovered bronze and were making fine sacrificial vessels, some of which can be seen in the British Museum. Other arts and crafts were developed, but always the Chinese remained agricultural, so that even to-day much the greater part of the population consists of

TEA GARDENS IN A FAMOUS GROVE IN CHENGTU

In Chengtu, the capital of Szechwan province, a well-known outdoor restaurant, patronised by members of the South-West Combined Universities, occupies a famous grove where noted poets of 2,000 years ago met to exchange verses and stories. In China, tea is drunk without milk or sugar from small bowls without handles. Around Chengtu is a plain, 2,000 sq. m. in area, and well irrigated, which is one of the most productive and densely populated regions in the world.

Cage-birds are very popular in China, and the owners often take their pets for an airing just as people in some other countries exercise their dogs. The fisherman in the lower photograph is preparing for his day's work. The cormorants are trained to return with their catch, which they cannot swallow because each bird has a rubber or expanding collar round its neck. Occasionally the fisherman removes the collars and rewards the birds with fish.

WORKING IN THE RICE FIELDS OF SOUTHERN CHINA

South of the Yangtse-kiang the staple food crop is rice, and the laborious back-aching task of transplanting the seedlings has to be done by hand. As the transplanting is done during the rainy season, each worker carries a grass cape tucked in his belt at the back (above). When it rains, he puts the cape round his shoulders and so keeps quite dry. The failure of the rice crop is a major disaster, as it may mean death by starvation for hundreds of thousands.

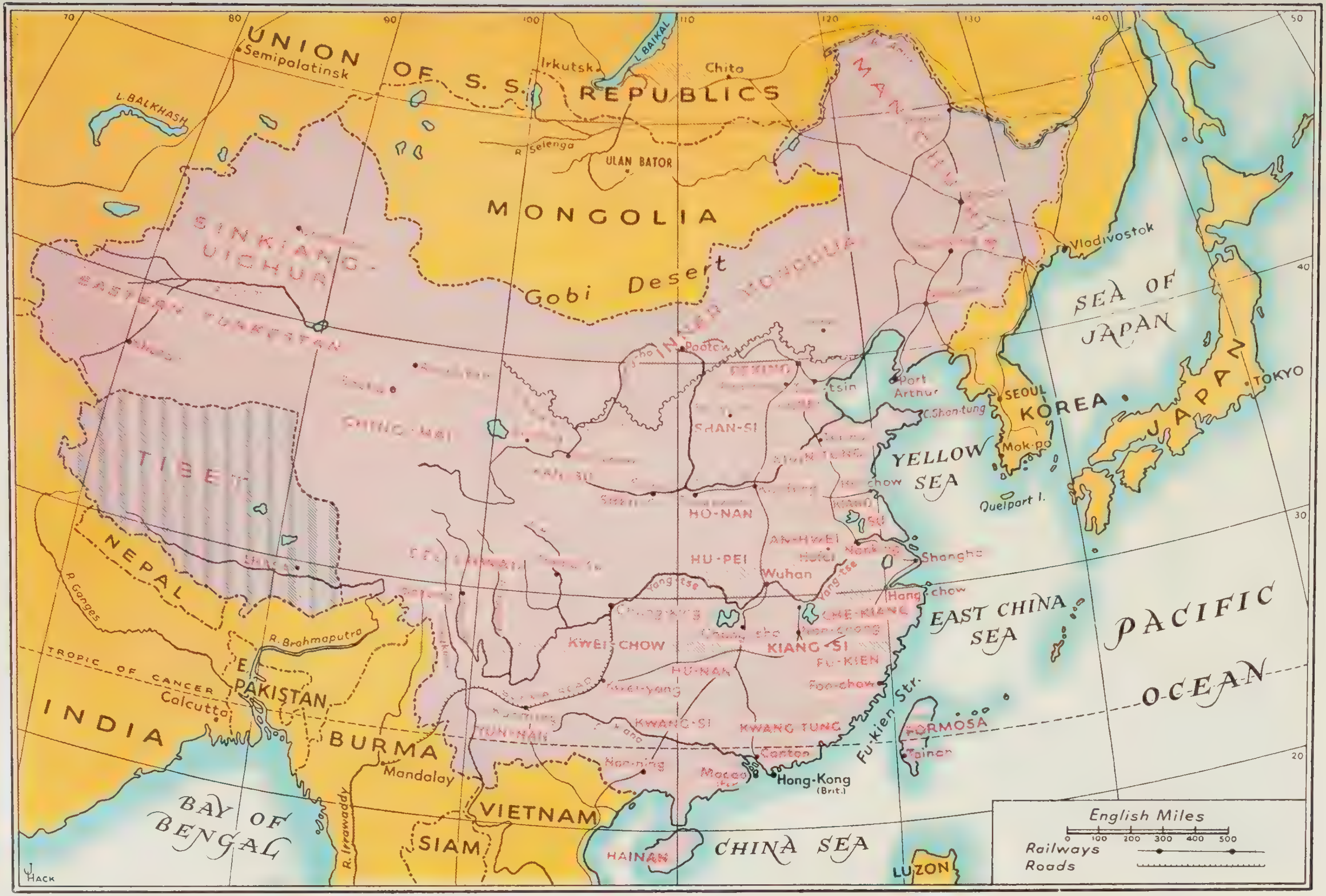
workers on the land. The people were not only self-supporting; they also exported many of their wares and large quantities of their food to neighbouring countries.

Chinese art, which has so captivated Western nations, began with prehistoric pottery of distinctive form and decorated with lines and geometrical patterns. The style continued in the early bronzes of the Shang dynasty (1766–1122 B.C.); by the end of the dynasty decoration had become conventionalised into bold patterns of animals and symbols. The general scheme of decoration was carried into the wall-paintings and incised carvings of the Han dynasty (206 B.C.–A.D. 221). At the same time painting on silk developed, in which free-arm design allowed great boldness of line. During all this period pottery was made and decorated, usually in the same fashion as was used in the bronzes, even the pottery shapes following the bronze tradition. Some authorities place the invention of Chinese porcelain in the Han dynasty, others maintain that true porcelain did not make its appearance before T'ang (618–907). In the earlier pottery and porcelain, decoration was restrained; during the Sung dynasty (960–1280) emphasis was on elegance of shape, and decoration was sparse or altogether absent. During the Ming dynasty (1368–1644), and even more during the Ch'ing (1644–1911), pottery and porcelain tended towards over-decoration and "fussiness". Yet, copying the models of the past, Chinese artists and potters have produced during all periods some of the loveliest examples of the potter's art. Sculpture reached its height between the 2nd century B.C. and the 7th century A.D.; painting was most excellent between the beginning of the Christian era and the end of the 13th century.

One characteristic of the Chinese which much impresses all who live in the country is the love of education. From about 1500 B.C. China had state schools where all who showed talent were educated without charge. If a village boy of promise could not afford to leave his work on the land and go to a school for education, all the members of the community would make their contribution to the cost of sending him to the district town to sit for an examination. Every success was thus an achievement of the whole village, and the bright boy brought lasting fame to his birthplace.

The written histories of China go back 4,000 years from our own times; this has led many people into thinking that the Chinese are conservative and unchanging. In fact the contrary is true. It is fair to say that China has, in her long history, tried all the forms of government known in other parts of the world, and Chinese records state that the perfect form of government has not yet been found and perhaps never will be discovered until man himself becomes so perfect as to need no form of government at all! Early Chinese philosophers (and particularly Confucius) concentrated on the study of human nature as the best chance of discovering how man could best govern and be governed.

In very early days the Chinese made a deep study of mathematics and astronomy. In Peking Obser-



COMMUNIST CHINA: STRIPES INDICATE THE DIFFERING STATUS OF FORMOSA AND TIBET.

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CHINA'S GREAT WALL: DEFENCE AGAINST INVASION FOR 2,000 YEARS

Stretching from Shanhaikwan, on the Yellow Sea, to the borders of Kansu and Sinkiang in the west, the Great Wall crosses high mountains and deep valleys. Its construction is estimated to have occupied half a million workers and even now, twenty centuries after it was begun, it is in a wonderful state of preservation.

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vatory are some early astronomical instruments dating from three thousand years ago. These studies were concerned only with the fixing of the seasons and the regulating of sowing and reaping ; the Chinese did not develop their studies to the point of pure research. When Babylonia and Assyria, ancient Egypt, and Greece were great powers in the world, China was the cultural mistress of Asia. These other empires have vanished, in some cases leaving little trace behind, but the Chinese still reverence their past and have preserved many of the early records. This is not only because the records are old, but also because it is a firm belief of the Chinese that the present can learn much of great value from what has gone before. Like all highly intelligent people, the Chinese were always anxious to know full details of anything new ; they thus became great travellers, and some of the most thrilling accounts of hazardous journeys across mountains and deserts are to be found in the Chinese language.

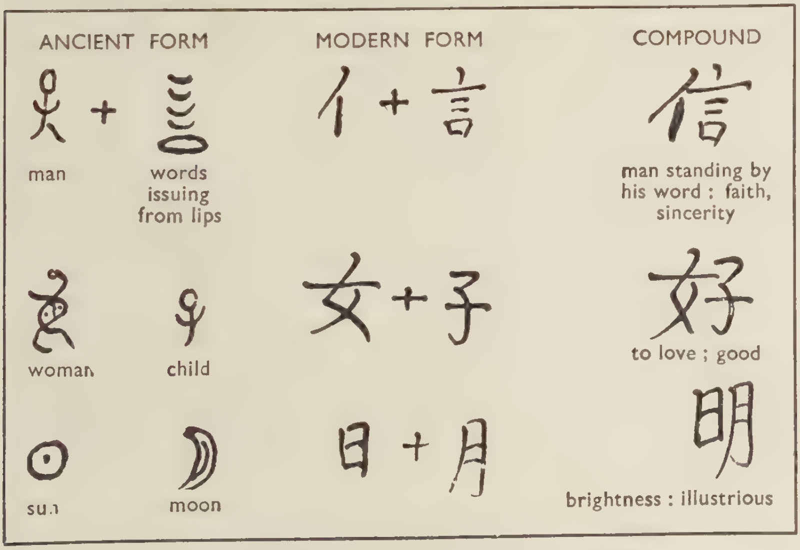
In spite of the large number of agricultural workers in China only about one-third of the entire area is cultivable, and not all of this is under cultivation. Moreover, China is a land of great natural disasters, *e.g.* the overflowing of the Yellow River, once named by an emperor " China's Sorrow " because of the tremendous loss of life and damage to crops caused by such inundations. Earthquakes occur in the north-west, destroying whole towns and villages over hundreds of square miles. The southern part of China comes within the monsoon lands of south-east Asia; if the monsoon (rainy season) fails, there is severe drought, and hundreds of thousands of people die of hunger. When winter snows are heavy on the mountain chains on China's western borders, the spring thaw brings floods along all the rivers ; then millions of acres of sown land are under water, the seeds rot, and the crop fails. As the Chinese proverb says, " If not drought, then flood ; how can man live ? " Of course, China has many good years when all goes well, but all these mischances are ever present at the back of the farmer's mind.

The Chinese are of the Mongolian division of the human race, that is to say, they have yellow skins, straight raven-black hair, high cheekbones, and "almond" eyes. They have a keen sense of humour, a fine appreciation of justice, are contented with little, very sociable ; they rarely seem to tire and, under whatever strain, they are invariably polite, especially to the guest in the house or the visitor from abroad. One thing that the European finds difficult to understand is the Chinese lack of a Western sense of time. If an appointment is made with a Chinese (never call him a " Chinaman ") for 10 a.m. on Tuesday, he may well keep it on Thursday at 4 p.m., and be surprised that his host is not ready to receive him at that time ! Perhaps this indifference to time and its pressures accounts for the Chinese freedom from nervous disorders. They are certainly wonderfully patient.

Chinese Language and Writing

To most foreigners the Chinese language with its beautiful script appears incredibly difficult. Because the language has no alphabet, because the Chinese write downwards in columns running from right to left so that the title-page of a Chinese book is where the last page of an English book would be, many think it nearly impossible for a foreigner to learn Chinese in one lifetime. The Chinese rulers are themselves aware of the difficulties of their writing, and late in 1957 the State Council approved in principle the use of a new phonetic written language using the Latin alphabet. But there was no intention of dispensing altogether with the beautiful Chinese script. The proper writing of this, done with a fine-pointed camel-hair brush, is considered a branch of painting.

Chinese writing was, like all ancient scripts, originally picture writing ; each sign was a drawing of the object to be represented. But not everything man can think about can be drawn as a picture, so some means had to be found of writing down ideas. When a sign (" character " is the word used in books) was wanted to represent *sincerity* or *belief*, two picture characters were put side by side to represent *a man* standing by his *word*; when it was necessary to write down *love*, the two words *woman* and *child* were put side by side in one character as the supreme example of human love. One may talk much of *brightness* without having any idea of how to depict it ; the Chinese put side by side the characters for the brightest things by day (the sun) and by night (the moon) and thus the new character came into the dictionary. So the main divisions of the Chinese characters are pictographs (writing in pictures) and ideographs (the writing of ideas). Naturally the pictographs are limited by the number of things whose outlines can be drawn, but



VARIOUS FORMS OF CHINESE CHARACTERS

A SOOTHSAYER OF KUNMING, CAPITAL OF YUNNAN

The Chinese are very superstitious and often consult a soothsayer before undertaking business of any importance, or fixing the date for a wedding. The bearded soothsayer is writing a forecast on the omens supplied by the books at his left hand, and on what he has been told by the boy holding the pigeon. For writing Chinese characters the camel-hair brush is held upright. The signs on the wall are conventional forms of the character signifying long life.

one can go on making ideographs for ever. The standard dictionary of the Chinese language has over 48,000 characters, but most of these are obsolete or different forms of other outlines. The most scholarly Chinese may carry some 15,000 characters in his head ; most people manage with no more than four or five thousand.

Although there are many spoken dialects, the written language is the same throughout China. If one travels in a district and cannot understand the dialect, one writes down what one wishes to say and it is at once understood. Thus throughout China a traveller can go without difficulty wherever he will, just as in medieval Europe a man knowing Latin had no need to learn the speech of any country through which he travelled. Moreover, the Chinese language has changed very little in style for some twenty-five centuries, so the works of Confucius can still be read as if they were new.

Naturally enough the Chinese have accumulated through four thousand years of recorded history a great body of writings of all kinds. Some of the most superb literature in the world is in Chinese. Early poetry was folk poetry ; this soon developed into a simple form very like the poetry of European nations, with different metres, rhyme, and varied length of poem. Chinese essays are beautiful examples of balanced prose. In Chinese literature, somewhere, is to be found the explanation of all that has happened in Chinese history, but the field is so vast that no man can cover it all in one lifetime. That is why many emperors in the past have appointed boards of scholars to compile collections of Chinese writings of all ages so that much time is saved by the scholar seeking in a hurry some historical fact which otherwise might not be found after months of searching. Thus the old custom of binding the feet of beautiful girls arose from the story of Fei Yen, a dancer who became the favourite of an early emperor, who was so small and light that she used to amuse the emperor by tripping dancingly across the lotus flowers in the palace pond. It was said that her feet were so small that she could stand on the palm of the emperor's hand. Fei Yen was most probably a superb midget.

The arts reached a high pitch of developed perfection in China many centuries before the Christian era ; all Chinese arts, with the exception of music, have been much appreciated in Europe during the past four centuries. In England and France especially, during the 18th and 19th centuries, there was a vogue (vaguely known as *chinoiserie*) for all types of Chinese decoration. European philosophers studied such classical Chinese writings as had been translated, and thus Chinese teachings began to exert a deep influence on Western thought.

China has no national religion. The earliest belief of the people was animism : every living or natural thing had its own spirit and individuality, man being supreme because of his command over many things. Later came Taoism, which was at first a mystical form of belief in nature : if man

WATER FOR THE THIRSTY FIELDS OF CHINA

At Lanchow, in the province of Kansu, huge water-wheels raise water from the Hwang-ho, or Yellow River (upper picture) to be carried by a bamboo aqueduct over the city wall to fields beyond. The current turns the wheels operating the pistons of pumps. Unfortunately these wheels revolve only when the water level is high. Four farmers operate a tread-wheel, which raises water from the Yangtse River to flood their rice fields (lower picture).

CELEBRATING A FESTIVAL IN YUNNAN

Yunnan is a province of south-western China, and its inhabitants have little in common with their fellow-countrymen in the north. The wide-brimmed hats worn by the peasants serve both as sunshades and as umbrellas. The celebrations taking place in this picture were held at Tali, a beauty-spot in the mountainous and densely forested province.

followed nature in all his actions he would " travel with and not against the stream." Simplicity of life and the lessening of desires was the chief teaching of ancient Taoism, but early in the Christian era the faith had degenerated into semi-magical superstition in which the search for the elixir of immortality had become the chief aim.

Confucius, the Sage of China, was born 551 B.C. He mastered all the writings up to his own day and from them prepared an ethical and social teaching which has been the standard of morality in China down to our own day. He did not claim that he revealed religious truth, he did not even claim originality for his teaching ; he taught the duty of man to his fellows, the filial obligations of children towards parents, the desirability of learning, the importance of sincerity and honesty, and the need for justice for every man. It has often been said that the persistence of the Chinese as a nation long after their contemporary civilizations have disappeared is due mainly to the adoption of the teaching of Confucius as standard in all schools soon after the Sage's death.

In the second century A.D. Buddhism was brought to China by Indian pilgrims ; during the next eight centuries that faith grew in influence, being adopted and protected by several emperors. Nestorian Christianity reached China in the eighth century ; soon after came Islam, and to this day in the north-west of the country many millions of Chinese are Muslims. If in north-west China one comes on the surname Ma, one may be certain that family will believe in Mahomedanism.

It is said that when man reaches the moon and looks back to earth the one thing he will be able to distinguish is the Great Wall of China. Built of brick and stone, this 1,400-mile-long barrier was set up in the third century B.C. to keep out the raiding Tartars of Mongolia. It is 20–30 feet high, with towers 60 feet high every few hundred yards, and is 15–25 feet wide at the top. All large cities of China have similar walls, with gates which were closed at night to give the citizens protection against surprise attack—for China has been envied by her neighbours throughout history, and many times these neighbours have invaded the country, seized the capital, and begun a new dynasty.

Some of these dynasties ruled well and lasted long, extending China's frontiers and uniting her far-flung provinces ; others misruled for a few years, and were then overthrown by revolution or invasion. One of the most powerful dynasties was that of the Mongol emperors (1260–1368), which culminated in the rule of Kublai Khan. Soon after his death a revolution drove out the Mongols, and the native Ming dynasty took their place. At first a time of glory and greatness, the Ming rule gradually deteriorated, and when the Manchus attacked from the north-east in 1644, the army was not ready to meet them, the government was weak, and the Ming dynasty fell.

At first the Manchus had to contend with much hatred, and their rule was correspondingly harsh. One of their measures was the order that all Chinese should grow the hair long, men as well as women ; when long enough, it was to be plaited into a queue or " pigtail " and left hanging over the shoulders. In this way, in any disturbance, it

[Continued on page 393.

MASTERPIECES OF CHINESE CERAMIC ART

Under the T'ang emperors (618 907) the art of making pottery figures intended for burial in graves reached a high level. The horse has a hole for the insertion of a tail, and a groove for the mane ; the pack-saddle of the Bactrian camel is embossed with a monster's head. The winged, hoofed, human-headed creature (bottom right) is an earth-monster or "t'u kuai." All these, and the human figure, came from the tomb of T'ing-hsün (d. 728). The urn is of red clay, covered with a white slip, and then coated with a transparent pale green glaze The red clay foundation is visible below the neck

From the collection of the late George Eumorfopoulos

HOUSEHOLD OBJECTS OF 16th AND 17th CENTURIES

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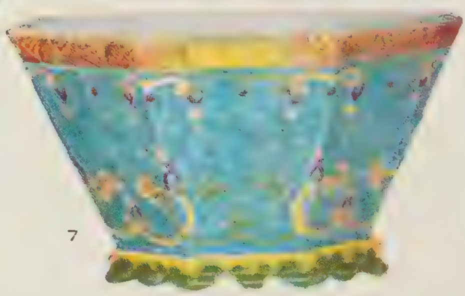

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1. Porcelain beaker with a Ming emperor in an historical scene. 2. Enamelled porcelain box, with mandarin administering justice on the lid (16th century). 3. Box with underglaze painting of flowers and animals in five colours (16th or 17th century). 4. Angular beaker in glazed stoneware with pattern in relief (16th century). 5. Wine jar with three-colour glaze, and relief ornament of the Chinese "Rip Van Winkle" watching the fairy draughts-players (15th century). 6. Stand for artist's colours in Mahomedan blue (16th century). 7. Porcelain wine vessel, with an incised pattern (16th century).

1, Victoria & Albert Museum; 3 and 6, British Museum; rest from the Catalogue of the Eumorfopoulos Collection, courtesy of Ernest Benn, Ltd

SPLENDID PIECES OF MING PORCELAIN AND POTTERY

Porcelain produced under the Ming dynasty (1368-1644) is distinguished by its use of colour and enamels. The two statuettes at top right and lower left are on ridge tiles of rough glazed pottery. The porcelain figure at top left is of Kuanyin, the Buddhist goddess of mercy and patron goddess of mothers and children. She is holding the Register of the Good, while the Judge of Hell (bottom right) has the Register of the Evil under his arm. Porcelain was really the last art to arise and flourish in China, though it was the art for which that country was first known to the West

Top left, from the collection of the late George Eumorfopoulos; bottom right, British Museum; rest, Victoria & Albert Museum

CHINESE CH'ING DYNASTY VASES

Art Institute of Chicago

After the complicated patterns and designs of Ming-dynasty porcelains came a period, early in the Ch'ing dynasty, when an attempt was made to re-create the self-colour undecorated shapes of the Sung dynasty. Top left is a bottle vase with peach-bloom glaze. In the centre is a clair-de-lune glaze vase which closely resembles the cold clear gleam of moonlight. The apple-green glaze of the lowest vase is crackled by the opening and closing of the kiln doors during the firing.

would be easy for the authorities to pick out Chinese from Manchus; also the queue was useful for getting a grip on an arrested prisoner. Resented at first, the custom soon came to be taken for granted; and when the Manchu dynasty was finally overthrown by revolution in 1911, and the republic which replaced it ordered all Chinese to return to the close-cropped fashion of pre-Manchu times, hundreds of thousands of Chinese resented the new order as bitterly as their ancestors had fought against the old one.

Opium or some distillation of it was from an early date used in China in two ways. In small doses opium is a stimulant, and it was anciently so used by heavy manual workers. In larger doses it is a soporific (sleep-making drug), and it was used, alternately with Indian hemp, as an anaesthetic. From these uses developed the habit of opium-eating and opium-smoking among the ordinary people. In the 18th century this had become a grave problem for the Chinese authorities. Early in the 19th century the British East India Company was exporting great quantities of Indian opium into China. The number of addicts grew until the government had to take action. The Chinese authorities gave warning that further imports would be confiscated. In spite of this, more arrived and, true to their word, the Chinese customs authorities seized it as contraband and destroyed it. The war of 1839–40 between Great Britain and China is known as the Opium War because it arose out of this seizure.

China lost the Opium War and, as a result of the Treaty of Nanking which embodied the peace terms, the Chinese government was pledged to open to British trade a number of coastal and Yangtse river towns, where foreigners could build and supervise their own premises and conduct trade in their accustomed manner. These towns and cities, chief among which were Canton, Amoy, Foochow, Wenchow, Ningpo, and Shanghai, were called Treaty Ports, and they became the great centres of Oriental trade, of immense value to Chinese and Europeans alike.

The revolution of 1911, which turned China from an empire into a republic, was planned by Sun Yat-sen (1866–1925), who had had an English education and wanted to introduce democracy into his country. But disagreements between the revolutionary leaders, and the impossibility of governing the outlying provinces, brought chaos and civil war, complicated by the activities of powerful semi-political bandits called war-lords, who ravaged the countryside and sold their support to the highest bidder.

When Sun died in 1925, the leadership fell to Chiang Kai-shek, who marched with a powerful army from the south in 1926, and in two years unified the country and established the rule of the Kuomintang, or Nationalist Party. But, just as his rule seemed to be on the way to success in settling the internal affairs of China, the Japanese invaded Manchuria (1931–32) as the first stage of their plan to conquer China, and from there on July 7, 1937, they launched full-scale war against north China. Swiftly cities and towns fell to the invader, and Chiang and his government were forced to withdraw south and west, where they set up their capital at Chungking.

In 1941 the China-Japan war became part of the Second World War. Thousands of labourers built the Burma Road, along which came supplies to the hard-pressed Chinese, until in 1942 Burma, too, fell to the Japanese. The Chinese continued guerrilla warfare, and they were not finally relieved until Japan's unconditional surrender to the Allies had taken place in 1945.

When Chiang had taken over the leadership of the Kuomintang, he had expelled all its Communist members; and these, after marching in a body the length of China, finally settled in Yenan, in the north-west, where they set up their own state and government. When Japan attacked in 1937, they co-operated with the Nationalists at first, but during the war the two parties quarrelled and at times were fighting each other even more bitterly than they were fighting the Japanese. After the Second World War this civil war between Nationalists and Communists was intensified. Advancing from their headquarters in the north-west, Communist troops captured first Nanking, the new Nationalist capital, and later Canton and Chungking. The Nationalists under Chiang Kai-shek then withdrew to the island of Formosa off the south-east coast, and by the end of 1949 the Communists were in control of the whole of the mainland.

Five-Year Plans

The new head of government, Mao Tse-tung (b. 1893), a Communist since 1921 and leader of the 6,000-mile "long march" of the Communists to Yenan in 1928, at once set about the double task of constructing a communist state on Russian lines, and modernising the age-old outlook of China. An atmosphere of energy, drive, and efficiency was generated. A series of "Five-Year Plans" was started. Iron and steel and chemical works were begun, with Russian help. Great building projects were put in hand. New railways were laid. The large estates were broken up, and the peasants won over with the gift of tiny holdings of their own. A complete change in the status of women was brought about: polygamy, child marriage, and marriage brokers were abolished; the murder of girl babies was stopped; women were given equal legal rights, and even the vote.

On the other hand, censorship went hand in hand with the mass "education" of the people in communist principles, and the power of the central dictatorship stretched through provincial, regional, and local committees down to the village councils in the remotest areas. Forced labour camps were instituted, and thousands of workers were herded thousands of miles from their homes. The peasant's half-acre was soon swallowed up in the collective farm. In the first seven years an unknown number of resisters—perhaps two or three million—were put to death.

At the end of the first Five-Year Plan the thin figure of the Chinese peasant still stood, as his forefathers for thousands of years had stood, wooden plough in hand, bent over "the good earth," earning a minute pittance with never-ending toil; while in the cities his brothers sullenly laboured to build modern skyscrapers with the same bamboo levers, wicker baskets, and bare hands as their ancestors had used to construct the Great Wall.

China-clay. There are two names for the white-burning clay which is used for making chinaware, or porcelain. The Chinese were the first to use it, so it is called either china-clay or kaolin, from Kao-ling, a hill close by a famous pottery centre in China, which produced early examples.

China-clay was afterwards found in many other parts of the world, but large deposits of good-quality material, such as could be worked commercially, are by no means common. The most important, by far, are in Cornwall and the western part of Devon, where there may be roughly 100 million tons. Other big deposits are in Czechoslovakia, Germany, France, the U.S.A., and Japan.

The clay is formed by the natural decomposition of the mineral feldspar, one of the principal minerals in granite and other related rocks. The process, known as kaolinisation, results in the formation of a clay mineral called kaolinite, which is a well-defined substance containing about 46 per cent. of silica, 40 per cent. of alumina, and 14 per cent. of water. Some china-clays also contain a small proportion of another clay mineral known as montmorillonite (the principal clay mineral in bentonite and many fuller's earths), which is believed to make the clay more plastic.

The West of England deposits have been famous for a long time. The three main producing areas lie around the St. Austell and Bodmin Moor districts in Cornwall, and Dartmoor in Devon. The granite masses in the west of England have, however, been kaolinised in places. The clay has resulted from the action of hot gases and vapours (such as superheated steam, boron and fluorine compounds, or carbon dioxide) which have arisen from inside the earth's crust and have attacked feldspar crystals in the granite and transformed the rock into a soft, friable mass. Powerful jets of water, like those from a fireman's hose, are brought to bear on the decomposed rock, washing the clay out as a milky stream that flows to a sump in the bottom of the pit or quarry. Here the clay slurry is pumped to the surface into wooden launders or concrete channels, called "drags," in which impurities such as mica, quartz, and undecomposed feldspar settle out. The clay is separated from the water either by allowing the slurry to thicken in settling-tanks or by means of filter-presses, and is then dried in a coal-heated kiln. The finished product is exported to many countries, including the U.S.A., Canada, Europe, and the Far East.

In normal times English china-clay ranks second only to coal as a raw-material export; during an acute shortage of coal it has ranked first. Much detailed scientific research has been carried out, and considerable attention paid to the modernisation of the industry during the 1950s, and many special products have been evolved.

The uses of china-clay are very varied, though contrary to popular opinion the quantity used in pottery forms only a small proportion of the total production—possibly not more than one-quarter. By far the largest amount is used in the manufacture of various classes of paper, ranging from the finest art paper to wallpaper. The paper on which

PURIFYING THE RAW MATERIAL OF CHINA-CLAY

The normal method of working china-clay deposits involves breaking up the hard raw material by high-pressure water jets after the valueless overburden (top earth) has been removed. In this picture the resulting mixture of clay impurities and water is being passed through a series of settling-tanks in which the impurities are deposited, leaving the fine clay in the water. China-clay was first used by the Chinese potters for the making of chinaware.

LOADING THE PURIFIED AND DRIED CHINA-CLAY

The china-clay is separated from the water in which it has been purified either by allowing the slurry (a thick pasty " porridge ") to thicken in tanks or by passing it through filter-presses. Finally, it is dried in coal-heated kilns.

this book is printed contains about 16 to 20 per cent. of china-clay. Other uses of china-clay are in the manufacture of certain kinds of rubber articles and paint, in white-cement, electro-ceramics, and refractories, in some chemicals and cosmetics, and in pharmacy. Kaolin is used for poultices.

Chinchilla. Several small, active members of the gnawing family called rodents are described as chinchillas, the best known being the Peruvian *Chinchilla laniger*, which is about 10 ins. in body, with a brush-like tail. Chinchillas live in the Andes mountains of South America, but since the days of the Incas they have been heavily hunted for their fur ; and the main supply to-day comes from farms in North America and Europe. This soft pearl-grey fur is the finest and softest in the world, because each hair splits into anything up to 80 strands. Several breeds of domestic rabbit are called chinchillas ; but though their fur is the same colour as chinchilla the two animals are not related.

Chipmunk. The wide-awake chipmunk of North America and eastern Asia (genus, *Tamais*), often called the ground-squirrel, is noted for its beautiful markings, the grey or reddish-brown fur being streaked with light buff stripes along the back and sides.

This rodent is about six inches long, with a bushy tail nearly as long as its body. In its roomy cheek-pouches it can carry surprising quantities of nuts and grains ; it also stores these for winter use in its underground home, which is a tunnel sometimes 20 feet long. This is enlarged at intervals into chambers which serve as storehouses, and leads to a tiny nest. The chipmunk will sometimes climb a tree to escape such enemies as the fox, but it prefers when hard pressed to make for its burrow, where it is not at the mercy of birds of prey.

Chlorine. In Victorian England many thousands of people, among them the Prince Consort, died of typhoid, cholera, and other diseases caused by impure drinking water. Nowadays the addition of a very small amount of chlorine to the water removes this risk. This seems strange when it is remembered that chlorine is a poisonous gas, and was in fact the first chemical weapon to be used in the First World War. One explanation for it is that the harmful bacteria die if exposed to oxygen, and chlorine has the power to liberate oxygen from water. Minute quantities added to the water in swimming baths prevent them from becoming foul with green slime.

Chlorine (symbol Cl, atomic weight 35) is an extremely active greenish-yellow gas, combining easily with a variety of other substances. Added to

CHIPMUNK, OR GROUND SQUIRREL

A member of the rodent family, the chipmunk of North America is related to the squirrel, and has the alternative name of ground-squirrel. It is a reddish or greyish brown beast, with light buff stripes along the back and sides.

chemicals of the phenol family (*see* CARBOLIC ACID) it forms the basis of many popular household antiseptics, *e.g.* "Dettol," "T.C.P.," and others. In combination with benzene, chlorine forms benzene hexachloride, the active ingredient of the insecticide "Gammexane," which is particularly potent against locusts. "D.D.T.," another valuable insecticide, contains the gas, and so do several of the selective weed-killers, namely those like "Verdone," which work by making weeds outgrow their strength. Chlorine is also an important ingredient of several solvents used in dry-cleaning and in removing grease from metals.

Although important, these uses do not absorb all the chlorine produced. Great tonnages in liquid form are used in the preparation and bleaching of paper-making pulp. Bleaching powder is chloride of lime. Its production to-day is declining, but some 150 years ago it caused a revolution in the treatment of cloth, replacing the slow and hazardous bleaching by the sun's rays, and making it possible for a large textile industry to develop in the region around Glasgow.

Large amounts of chlorine go into the manufacture of the plastic polyvinyl chloride ("P.V.C.",) which has many uses, the best known perhaps being as leathercloth for upholstery in the home and in motor-cars. But perhaps the largest amount of all goes into manufacture of hydrochloric acid (see article).

Many of the newer uses, especially in plastics and insecticides, were developed in the 1930s, when industry was demanding huge quantities of pure caustic soda, much of it made by passing an electric current through a solution of common salt (NaCl). This causes the salt to split into sodium and chlorine; the sodium combines with the water to produce caustic soda, leaving a residue of chlorine. Chlorine is also a by-product of the industrial manufacture of pure sodium, again by the use of electric currents.

Chlorine, though known to the alchemists, was not seriously studied until 1774, when the gas was investigated by the Swedish chemist Scheele. The gas is now in great demand for its own sake as one of the most important of industrial chemicals.

Chopin, FRÉDÉRIC FRANÇOIS (1810–49) (approx. pron. shō-pan). Over a century has gone by since Chopin died, but in concert-hall and drawing-room alike this "poet of the piano" retains the deep affection of musical people by virtue of the delicate lyrical beauty of his work.

Chopin was born near Warsaw, in Poland. His father was French and his mother Polish. Try to remember this when you listen to his music, for you will find typically Polish melody and fire combined with the neatness and gracefulness for which French music is noted. He learnt to play the piano when he was very young, and became so accomplished that by the time he was nine he was well known to the nobility of Warsaw. At the age of 14 he played to the Emperor of Russia, who paid a visit there.

When he was 19 he went to Berlin and a year or two later to Vienna, where his playing was a good deal criticised and discussed. Using Vienna as a centre, he visited Dresden and Prague and other big cities, and so became more and more widely known, principally as a pianist. It was Robert Schumann (see article) who first helped young Chopin to proper recognition as a composer. At this time Schumann edited a musical paper in Vienna. In it he wrote an article about one of Chopin's works, and used the now famous words: "Hats off, gentlemen—a Genius!"

When he was 22 Chopin moved to Paris, where he made many friends among the principal musicians. Though he became famous and made a great deal of money, he was always willing to do all he could to help any poor Pole who might come to Paris. At one time he had thought of going to America, because living was so costly in Paris; but his admirers urged him not to do this. So he stayed on, and his fame increased and many pupils came to study with him.

He had never had really good health, and eventually, while still a young man, developed tuberculosis. This caused him to visit England to see a famous doctor. He came to England again in 1848 and played in London and Manchester, and went on to Edinburgh and Glasgow. He was desperately weak by now, and sometimes had to be carried upstairs to play: so weak, in fact, that the Scottish hospitality exhausted him. After this British tour he went back to Paris, where he died the following year.

CHOPIN, POET OF THE PIANO

Essentially a composer of pianoforte music, Frédéric François Chopin based many of his works upon rhythms of Polish national dances. His popularity remains undimmed.

Chopin was essentially a composer of pianoforte music, and as such occupies a unique position. His works are polonaises, mazurkas, waltzes, nocturnes, ballades, impromptus, scherzos, studies, preludes, and two concertos. Many of these are based upon the rhythms of Polish national dances, and reveal the marked individuality of the composer. In his knowledge of the resources of the piano and in his genius for the composition of exquisite passages which display the piano's most delicate and characteristic effects, Chopin possessed powers which have never been surpassed.

He was most careful to avoid melodic, rhythmic, or harmonic commonplaces. A vulgar melody or a halting rhythm was repugnant to him, and his ultimate aim was the attainment of refined harmony. In a few of his last pieces even lovers of Chopin's music consider that he may have overshot the mark and lost some of his refined rhythm and harmony.

The STORY *of the* CHRISTIAN CHURCH

Christianity. Undoubtedly the most powerful single influence on the whole course of human history has been the Christian religion. In recognition of this influence the greater part of the civilized world, whether Christian or not, divides history into the two eras : B.C. (Before Christ) and A.D. (*Anno Domini*, in the year of the Lord), the years of our present era, A.D., dating from the supposed year of the birth of Jesus Christ, the central figure of Christianity. It is also the most widely spread of the world's great religions, claiming more adherents than any other. The official number to-day is 692,400,000.

Yet Christianity at no time took the world by storm. At the time of the death of Jesus (probably A.D. 29) His group of immediate followers numbered scarcely 100 persons. They soon began to assert publicly their belief that Jesus had been raised from the dead and was revealed as the Son of God, and they were prepared to undergo persecution and even death for this belief, which is still the basis of all Christian doctrine. The belief spread rapidly among the Jews, of Jerusalem and elsewhere, to whom the Apostles first addressed themselves. It was their most remarkable Jewish convert, Saul of Tarsus (a city of Asia Minor), who, under the name of Paul, did most to spread the new faith among the Gentiles, or non-Jewish peoples. During more than 30 years of unceasing activity Paul established centres of Christianity at many places in Asia Minor and Greece. During his ministry the followers of the religion were first given the name of Christians at Antioch (Acts xi, 26). At the first great council of the Church, held in Jerusalem about A.D. 49, it was established that the Christian Church was to be a universal body, not just a Jewish sect ; and it has remained a missionary religion to this day.

By the close of the 1st century A.D. there were Christians everywhere in Asia Minor. By A.D. 150 the Roman Empire was studded with their churches, some few of these existing even as far east as Arabia, Persia, and India.

With its insistence upon the ultimate importance of every individual, and its doctrines of humility and brotherhood, Christianity won most of its early converts among the poor and oppressed, to whom other religions had offered no hope of personal betterment. When its followers refused to worship the Roman Emperor as a god, systematic efforts were made to suppress the new religion. There were widespread persecutions under the notorious emperor Nero in A.D. 64, and under Domitian in 95. The last and most severe persecutions were under Diocletian, between 303 and 311. Christians were deprived of their privileges as Roman citizens, and were thrown to wild animals in the arena, or tortured and burnt alive. But in 311, Galerius, ruler of the East Roman Empire, issued an edict allowing Christians to worship as they pleased. Then in 313 the emperor Constantine gave every person freedom to practise the religion he preferred ; and in 324 he established Christianity as the state religion.

From Wilpert, "Le Pitture delle Catacombe Romane"

CHRISTIANS IN THE CATACOMBS

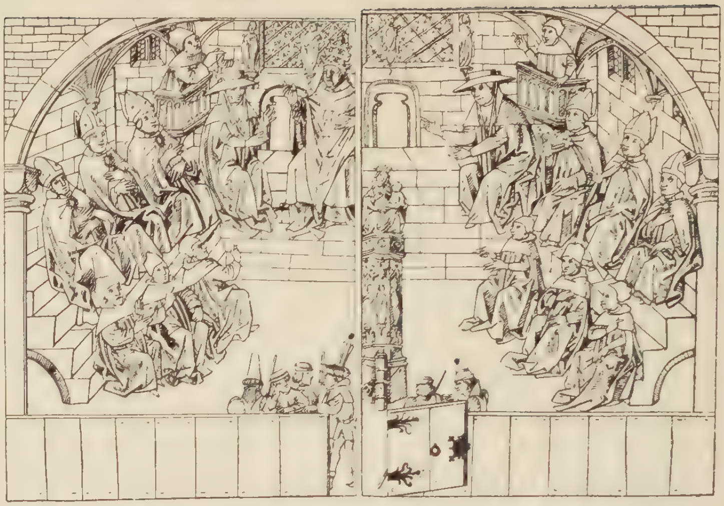
On the walls of the underground catacombs of Rome are the earliest known artistic representations of Christianity. The portrait (left) of one of the faithful at prayer dates from the fourth century ; on the right is seen an early Christian (probably a priest) named Liberius.

Constantine called together in 325 a general council at Nicaea, at which the entire Christian Church was represented. This council drew up and adopted the Nicene Creed, the name of which is derived from that of the town. This became the basis of all Church doctrine and Christian belief from that time forward.

While Christianity was conquering the world, its followers were grouping themselves into small local societies, or churches. They met in private houses, where they prayed, sang hymns, and commemorated the Last Supper of Jesus Christ with His disciples. Converts were admitted by the rite of baptism. Certain officers called presbyters, or elders, were chosen to conduct the services and instruct the converts. The chief presbyter was called a bishop, from the Greek word *episkopos*, meaning overseer. Each church also had deacons, who visited the sick and relieved the wants of the poor. At first all members of a local church had an equal voice in its government ; each church was an independent, self-governing community. Later the office-bearers became a governing council, with

the bishop at its head. But as converts increased and these communities gained in size and strength, local churches began to act together, and there gradually arose a system of Church government modelled on that of a civil state such as the Roman Empire. The head of the Church became the Pope, the bishop of Rome, who claimed, as successor to St. Peter (traditionally the first bishop of Rome), supreme authority in all matters of faith.

Christianity became firmly established over the countries of Europe, and the Church was a predominating influence there throughout the Middle Ages. All education was given by the Church; all learning was vested in the Church.



PRELATES AT THE COUNCIL OF CONSTANCE

The doctrines of the early Church were formulated by councils at which prelates met. This contemporary print shows the Council of Constance which opened in 1414. Its object was to end the Great Schism, which had led to the election of Popes both at Rome and at Avignon, in France.

The clergy, or officers, were distinguished by their shaving of the crown of the head (tonsure) and by their distinctive dress. They were required to take a vow not to marry, known as the vow of celibacy. They enjoyed the benefit of clergy, the privilege of trial by a Church court. There were two classes of clergy, the regular clergy (monks and friars), who lived according to the rule (Lat., *regula*) of an order, and the secular clergy, those who lived in the world as bishops and parish priests.

Among the principal duties of the clergy was the administration of the sacraments. These had come to be seven in number: baptism; confirmation; the Holy Eucharist or Lord's Suppper; penance (which included contrition for sins, sincere confession to a priest, satisfaction for the wrongdoing, and absolution); marriage; extreme unction, or the anointing with oil of those about to die; and holy orders, by which laymen were raised to the priesthood. After the Reformation many Protestants rejected most of these sacraments, retaining only baptism and the Lord's Supper.

It became customary for a priest, when granting absolution to one confessing, to prescribe some "penance" for the sins. An "indulgence," or a remission of the temporal punishment for sin, might be granted after sacramental absolution (forgiveness). Such indulgences were granted by way of reward for good works. Abuses which grew up in the granting of indulgences led to great revolts against the Roman Church later.

Offenders against Church doctrine and rule could be disciplined by excommunication (expulsion from the Church) or anathema (a formal cursing), which cut them off from the privilege of the sacraments and perhaps even from any association with the faithful. Whole cities or countries might be deprived of the usual services of religion by the interdict. On the other hand, persons fleeing from justice or persecution might take refuge in a church or its precincts and claim the right of sanctuary, or protection against arrest and violence.

The bishop, apart from his rank in the Church, was often a powerful figure in the civil affairs of his locality. His church or cathedral (see article) was situated in the principal city of the diocese. A cathedral chapter, consisting of members of the clergy called canons, assisted the bishop.

As the Church grew in power and influence, it was troubled by many disputes, within and without. There was constant friction, on questions of Church government, with the eastern branch headed by the patriarch of Constantinople, which refused to recognize the supremacy which the Pope in Rome claimed over the entire Church. This resulted in the separation in 1054 between the Roman Church and the Orthodox Eastern or Greek Church. From 1378 until 1417 (when the Council of Constance ended the breach) there existed the Great Schism, with rival Popes at Rome and at Avignon, France.

Origin of the Reformation

Graver disputes about faith and Church rule came to a climax in the 16th century in the great upheaval known as the Reformation, which was a revolt not only against the Roman Catholic Church as an organization, but against many of its religious doctrines as well. In Germany the storm broke on All Saints' Day, 1517, when Martin Luther posted on the door of the castle church at Wittenberg his Ninety-five Theses against Indulgences (*see* LUTHER; REFORMATION). Out of this religious revolution grew Protestantism, with its many diverging groups.

In Switzerland the Reformation was headed by Ulrich Zwingli, who won many converts, especially in the cities. John Calvin, a French priest who left the Church, carried on the work of Zwingli in Geneva, and clarified and organized Protestant doctrine. Calvinism, from which modern Presbyterianism and certain kinds of Methodism are derived, became a great force in Geneva and elsewhere, particularly in Scotland. In France the Huguenots, who took their organization and form of belief from Calvin, gained a strong foothold.

The reform movement in England followed a different course. In fact, it began as a diplomatic rather than as a doctrinal dispute. When Pope Clement VII refused to annul the marriage of Henry VIII with Catherine of Aragon, the king persuaded Parliament to pass Acts that freed the English Church from the power of the Pope. After Henry had got Archbishop Cranmer to pronounce his divorce from Catherine, the Pope excommunicated the king, and the breach with the Church of Rome was complete.

By the Act of Supremacy of 1534 the king became supreme head of the new national Church. This remained Catholic, however, in theology and forms of worship, and did not diverge from the Roman forms until the publication of the Prayer Books of 1549 and 1552, during the reign of Edward VI. Under Mary Tudor the movement was checked and the English Church was reunited to the Church of Rome. Queen Elizabeth I restored the Reformed Church, and by the Act of Supremacy of 1559 she was made supreme governor of the Church of England. An Act of Uniformity again established Protestant forms of worship, and the doctrine of the Church of England was formulated in its Thirty-Nine Articles (1576), which remain the official statement of its faith. Because of its unbroken succession of bishops, the English Church, though called Protestant, has always maintained that it has a claim to be part of the historic Catholic Church, but Rome does not admit the validity of the claim.

Many Englishmen were not satisfied with the new state religion, and desired more radical reforms, such as would do away with all observances not based directly on the Scriptures. These Puritans, as they were called, soon broke up into groups, which differed not only in doctrine but in the forms and methods of Church government. Among such were the Independents (later called Congregationalists), who went back to the original ideal of the Church as consisting of so many independent and self-governing communities or congregations; the Baptists, who could not accept the efficacy of any baptism but that of total immersion for adults; the Society of Friends, or Quakers, followers of George Fox, who rejected all sacraments and followed the doctrine of the "Inward Light." These branches of Christianity were all developed in the 17th century, often at tragic personal cost to their adherents. In the 18th century John Wesley found the machinery of the Church of England too formal for the Christian message which he felt inspired to preach to the world, so he organized his own great Methodist community. All these branches of the Protestant Church were taken to the New World; and all promoted evangelising missions to other parts of the world, as indeed did the Roman Catholics.

The three great branches of Christianity to-day are still the Roman (Western) Church, the Greek (Eastern) Church, and the Anglican and various other Protestant Churches. It is perhaps in the nature of Protestantism that it should be continually sub-divided. Even some of the various dissenting, or noncomformist, groups in England suffered from their own internal disagreements in the 19th century. The Presbyterian Church of Scotland was disrupted for nearly 60 years. In the Church of England itself there was, and sometimes still is, bitter controversy between the High, or Anglo-Catholic, party and the Low, or Evangelical, party. Many smaller Christian sects have emerged, like the Plymouth Brethren, the Christadelphians, the New Church (Swedenborgian), and the Four-Square Gospellers. Nevertheless the 20th century has seen a marked tendency towards reunion among Protestants—among Scottish Presbyterians and the various branches of English Methodism, and most notably in Canada and in the United Church of South India. Moreover, even where there is no reunion, there is certainly greater unity of spirit and purpose than at any other time since the Reformation. (*See* BIBLE; JESUS CHRIST; *also* CHURCH OF ENGLAND; ROMAN CATHOLIC CHURCH, etc.)

The GREAT SEASON *of* GOOD WILL

Christmas. December 25 is observed throughout the Western world as the birthday of Jesus Christ, the Founder of the Christian faith.

No one knows for certain either the year or the exact date of His birth; indeed, in the earliest existing records of any Christmas celebration, in Alexandria, Egypt, early in the third century, the date was taken as May 20. Later the celebration was moved first to April, then to January. The present date was not fixed until the 4th century.

The end of December was already the season of various pagan festivals connected with the winter solstice (*see* EQUINOX AND SOLSTICE) which had been celebrated for thousands of years before the Christian era. The early Christian Church found it advantageous to take over many old festivals and to give them explicitly Christian associations. That is why Christmas customs to-day still preserve features of the old pagan celebration. The season had always been greeted with special merriment and rejoicing as the turning-point of the year. It was made an occasion for happy family gatherings and general hospitality. Northern peoples went out into the woods to cut Yule logs for their fires. They decorated their homes with the bright green and red of the holly. They collected the sacred mistletoe from the branches of the oak where it grew, and hung it over the entrances to their homes to keep away evil spirits. They ate heartily and quaffed special drinks from great bowls. You will recognize all these things as part and parcel of the modern Christmas celebrations, even in the most devout of Christian households.

It was during the Middle Ages that Christmas first began to assume its present significance as a holiday as well as a religious festival. By Tudor times the festivities had been extended in England to last twelve days, that is to say, until Epiphany or Twelfth Day, January 6—hence the "Twelve Days of Christmas" of the old song. Throughout that time, high and low, old and young, gave

themselves over to feasting and merrymaking. In the great houses and castles, the revels were presided over by a mock official known as the Lord of Misrule or Abbot of Unreason, who saw that a traditional spirit of topsy-turvydom prevailed, typified by the meal at which servants were waited upon by their masters. (In the Royal Navy officers still wait on ratings at Christmas dinner.)

The Puritans condemned all such Christmas practices, and in 1644 the keeping of Christmas was forbidden in England by Act of Parliament, even the eating of plum pudding and mince pies being frowned upon. December 25 was ordered to be kept as a market day. After the Restoration (1660) the old customs came back, though never with quite the same wild revelry, for tastes were altering. During the 18th century special emphasis was placed in England on the idea of Christmas as a season of hospitality and of special bounty to the poor. Moreover, the Presbyterians of Scotland and the English nonconformists both continued to disregard Christmas. Scotland transferred its winter holiday to New Year's Day, and still tends to pay far less attention to December 25 than is paid in England. The English nonconformists returned only gradually even to the religious observance of Christmas Day as late as the second half of the 19th century.

Festival of the Family

The "old-fashioned" Christmas of the English countryside might have been in some danger of dying out early in the 19th century, as more and more people began to live and work in busy towns. That it survived in English cities and suburbs, though modified in character, was probably due in the first place to the fact that the 19th century was a period of large families. Christmas had always been very much a time of family reunion. Now it became increasingly a children's festival. The novelist, Charles Dickens, also did much to persuade people of the importance of keeping Christmas as a special season not only of jollity but of kindliness, and undoubtedly helped to give the season much of its present character. In the 20th century, in spite of two world wars, men and women in Christian countries still listen for the Christmas bells and have learned to cherish more than ever, if only for one day in the year, that great ideal of which, according to the Bible narrative (Luke ii), the angels sang on the night of Christ's birth: "Glory to God in the highest, on earth peace, good will toward men."

Almost every land of Christendom has its own Christmas carols to echo that song of the angels. In England, parties of "waits" still sing at people's doors on Christmas Eve, as they have done for centuries, even though they are nowadays preceded all too early in the year by youthful imitators who are little more than a nuisance. Many old English carols both beautiful and quaint have been rediscovered in the present century. The French *Noël* songs and the German *Krist Lieder* are famous.

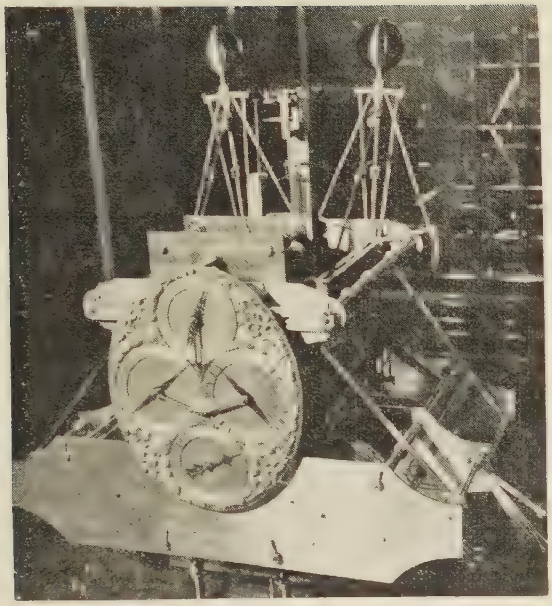
The custom of giving presents is said to go back to the days of the ancient Romans. But it also recalls the gifts brought to the Infant Jesus by the Wise Men, as told in the Bible story (Matthew ii). The Church commemorates this incident in the Feast of Epiphany, January 6, and in Spain and Italy, and in some other countries predominantly Roman Catholic, children do not usually receive their presents until that day.

The name of Santa Claus comes through the Dutch from Saint Nicholas, who was the special friend and protector of children. In the Netherlands, December 6, Saint Nicholas's Day, is observed as the children's festival, on the eve of which the saint is supposed to come riding from Spain with presents for all good children. The children leave a shoe in the hearth to receive the presents he brings, also a carrot for his horse. Early Dutch settlers in America took this tradition with them. English settlers adopted it, but transferred its observance to Christmas Eve. The shoe became a stocking (or pillow-case for the greedier optimists), and Santa Claus became the familiar white-haired, red-cloaked figure who rides from the North Pole in a sledge drawn by reindeer and enters the house by way of the chimney. Only towards the close of the 19th century was this American tradition generally taken up in England, and Santa Claus identified with Father Christmas (or, as French children call him, *Bonhomme Noël*). In some Baltic lands the gifts are supposed to be brought by the Christ Child (*Kris Kringle*) himself. In Italy presents are drawn from an "Urn of Fate," a custom that has come down from ancient Rome. There is excitement at the drawing, for some of the parcels have nothing in them, though of course nobody is left disappointed in the end.

The Christmas tree, with its dainty decorations, lights, and its shining star at the top, first appeared as a regular feature of the season in Germany in the 18th century. In Germany it is the custom for the family party to join hands round the Christmas tree and sing together. Christmas trees became popular in England after Queen Victoria's husband, the Prince Consort (who was German by birth), had provided one for a children's party at Windsor Castle in 1841. They are now considered essential in most Western countries.

According to the Church Calendar, the day after Christmas is Saint Stephen's Day. Everyone knows the old song about good King Wenceslas looking out "on the Feast of Stephen," that is to say, on December 26. But it is more commonly known as Boxing Day, because of the custom of bestowing Christmas "boxes" or presents of money to servants, tradesmen, and those who render public service. In England it is also a Bank Holiday; and all good boys and girls will no doubt be sure to spend at least part of the day in writing prompt letters of thanks for their presents.

Chromium. In 1913, Henry Brearley of Sheffield was experimenting with alloy steels for gun barrels. Among the samples he discarded as useless was one containing about 14 per cent. of chromium (symbol Cr.; atomic weight 52). Some months later he saw the pile of scrap. Most of the pieces were rusted, but the chromium steel was still bright. This fortunate accident led to the development of stainless steel, used for the cutlery seen to-day on most dining tables. It was later found that by adding more chromium and some nickel to Brearley's original formula, stainless steels could be made which resisted corrosion and heat still better, and these are now used in chemical plants and in modern dairies—but only



FIRST MARINE TIMEKEEPER

After seven years of hard work this chronometer was produced in 1735 by John Harrison, son of a carpenter. It proved successful, but Harrison was by no means satisfied, and went on to make even better timekeepers.

where they are essential, because alloying with chromium makes the steel ten times as expensive.

Chromium possesses the power to toughen steel. Alloys of steel and chromium—the so-called chrome steels—are used in steel tyres, ball bearings, files, rock-crushing machinery, and armour plate. Metal cutting tools are made from alloys of steel with chromium and other metals to give them resistance to great heat. Used alone, the steel would melt at the high temperatures and speeds required by modern industry. These alloy tools, however, will cut through the hardest metals like a hot knife through butter—and will continue to cut for some time even when the tip gets red hot. Plating with chromium gives the headlamps, bumpers, and radiators of cars their gleaming, rust-resistant finish, the chromium being deposited on the steel parts by electrical action.

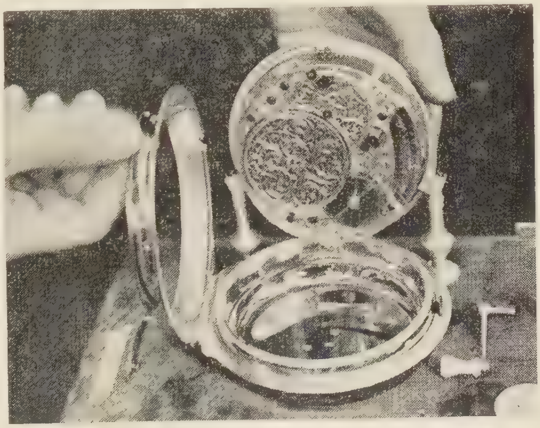
The commonest source of chromium is an ore called chromite, which contains chromium, iron, and oxygen. More than 2,500,000 tons are mined every year, the largest quantities in Russia, Turkey, South Africa, Rhodesia, and the Philippines. Smaller amounts are obtained from Yugoslavia, India, Greece, and Japan. Chromite is processed by being heated with coke to a very high temperature in an electric furnace. The resulting product is bluish-white, exceptionally hard, and melts only at temperatures of over 1,900°. Purer chromium can be obtained by heating chromite with powdered aluminium. About half the ore mined is used by the metal-working industries.

The third major use is in the manufacture of various chemicals. The compounds and ores of chromium are all highly coloured, so it is not surprising to find many of these chemicals used in dyeing wool and silk, and as pigments for paints, rubber, linoleum, and pottery. Artists speak of chrome yellow, chrome red, chrome green, and chrome orange, and these compounds were in common use long before the metal itself became important. The very name of chromium is derived from a Greek word meaning colour, and was chosen by the man who in 1797 first isolated the metal from one of its ores. He was a Frenchman, L. N. Vauquelin (1763–1829), who rose from humble origins (he was a ploughman's son) to be one of the great chemists of his time.

Other chromium compounds are used in tanning, in photography, in making safety matches, as catalysts in making aviation petrol, and in distilling methanol, a valuable industrial alcohol. Although generally spoken of as a minor metal, as indeed it is when compared with, say, iron, chromium is to-day assuming high importance.

Chronometer. The separate articles on Navigation and Latitude and Longitude explain how a ship's navigator finds his way across the oceans, and periodically checks his longitude by reference to the ship's *local time* as compared with *Greenwich time*. This method of finding longitude was first suggested by Regnier Gemma Frisius (1508–55), a Dutch astronomer; but for over 200 years thereafter it could not be put into practice because of the lack of a reliable timepiece that would go on board ship. The only other way was by observation of the moon and reference to tables giving the moon's distance from certain stars. It was for the purpose of observing these stars accurately that the Royal Observatory was established at Greenwich in 1675.

Finding longitude by difference of times meant (1) telling by solar observation the exact instant of noon; and (2) finding out the difference between this local time and the time at the same instant by Greenwich. The second requirement demanded a highly accurate clock; though it might gain or lose a tiny amount in, say, the 24 hours, this was not a great drawback if its "rate" was uniform and constant (this means if it gained or lost always at the same rate, a correction could then be made to obtain the accurate time).

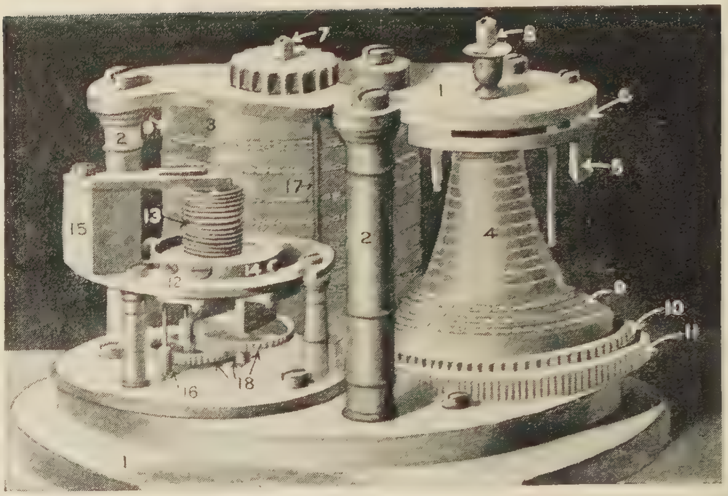


HARRISON'S FOURTH CHRONOMETER

John Harrison's fourth chronometer, completed in 1759, was made like a big watch. It won for Harrison a reward of £10,000 (not paid in full however, until he was 80) offered by the British government in 1715 to anyone discovering a method of finding longitude at sea.

In 1714 Parliament passed an Act offering a reward to anyone who should discover a method of finding longitude at sea; if the method proved accurate enough to determine a ship's position within one degree (60 miles), the inventor or discoverer was to receive £10,000. Still greater accuracy, to within 40 minutes of arc, would increase the reward to £15,000; should the method establish a position with the accuracy of half a degree, the reward would be £20,000. These were huge sums in the money values of those days.

John Harrison (1693–1776) set himself to the task of making a clock accurate enough to win the prize. He was born at Foulby, Yorkshire, the son of a carpenter, and such mechanical knowledge as he possessed was self-taught. He invented a pendulum in which the effects of temperature changes were compensated, and made other important improvements in timekeepers.



CHRONOMETER MECHANISM

The mechanism is indicated here. 1. Plates; 2. Connecting pillars; 3. Mainspring barrel; 4. Fusee; 5. Chain stop; 6. Cam acting on chain stop; 7. Staff of main spring; 8. Winding staff; 9. Fusee chain; 10. Maintenance wheel; 11. Great wheel; 12. Regulator plate; 13. Balance spring; 14. Balance wheel; 15. Bracket; 16. Pinion for seconds hand; 17. Main staff for hour and minute hands; 18. Pinion wheels.

John Harrison made five chronometers in all, and his fourth instrument satisfied the government's conditions. It was tried on a voyage to Jamaica in 1761, and after 61 days' sea passage it gave the time so accurately that the longitude could be determined to within five minutes of arc, or five geographical miles. Harrison had made his first chromometer in 1735, after seven years of labour and experiment; it was tried on a voyage to Lisbon and back, and proved a success. A second chronometer, with various improvements, was finished in 1739, but Harrison was not satisfied, and went on to make his third instrument. He had many setbacks, and had to keep worrying the government commissioners for sums of money to pay for his work and materials, and to meet his household expenses. For a time he had even to continue working at his trade as a carpenter in order to make a living. He exhibited the third chronometer to the Royal Society in 1749, and was awarded the Society's gold medal for that year. Not until 1758 was this timekeeper finished and ready for trial. By the time that the government had arranged for a ship to try it on a voyage to the West Indies, Harrison had made his fourth chronometer—this time a smaller one in the form of a large watch, and it passed its exacting test admirably, as we have said.

More delays and disappointments awaited the unfortunate clockmaker, and the commissioners required further and much more exacting tests. However, in 1764 he received £1,000 on account, though Parliament by then had passed an Act to allow him to be paid five times that sum as part of the reward. Next year he wrote a pitiful letter of protest to the commissioners. He had received altogether £2,500 by now, and the Act empowered the paying of a further such sum, making half the reward; the rest was to be given to Harrison when other chronometers had been made after his design and had proved satisfactory. Captain Cook used one of these replicas in his three-year voyage round the world. At last, in 1773, the inventor obtained the remainder of the money that was due to him. Three years later, at the age of 83, he died.

John Harrison had given 45 years of his life to his task, at work requiring the highest skill and precision in a period when tools were far indeed from their present-day accuracy. He introduced the idea of temperature compensation by a bimetal strip, making his balance "curb" of two thin strips of brass and steel riveted together in several places. In hot weather the brass, expanding more than the steel, made the curb convex, bulging on the brass side; on the curb were two pins between which the balance spring vibrated, and this had the effect of making the spring vibrate more slowly. In cold weather the rim became convex on the steel side and allowed the spring to vibrate more quickly.

These movements cancelled out, to a great extent, the tendency of the chronometer to go faster in hot weather than in cold. Harrison also did much to reduce the friction of the wheel pivots. Harrison's four chronometers and the copy of No. 4 used by Captain Cook are to be seen in going order at the National Maritime Museum at Greenwich.

The importance of the chronometer in navigation has been somewhat reduced in modern times by radio time-signals and by systems of navigation not based on astronomical observations. Nevertheless all ocean-going vessels and many aircraft still carry one or more chronometers lest these newer devices should break down. (*See* CLOCKS AND WATCHES.)

Chrysanthemum. Most of the beautiful English autumn-flowering chrysanthemums have come from a species which first grew in China. This was cultivated in Japan quite 2,000 years ago and became the Emperor's symbol in the 14th century. In 1764 it was brought to England. About the same time an Indian species

CHRYSANTHEMUMS OF MANY KINDS

Specially drawn for this work by E. C. Mansell

Surprising extremes of form are to be found in this showy flower, which originated in the Far East. There are very many hybrids. Every autumn Japan holds a chrysanthemum festival where all kinds are shown, including button-size varieties of 4. Those shown here are : 1, Early-flowering Japanese type ; 2, Koreans, a single type ; 3, Exhibition incurved ; 4, Rayonnante ; 5, Single-flowered variety ; 6, Japanese decorative varieties ; 7, Reflexed exhibition Japanese ; 8, Large Japanese Shaggy ; 9, Incurved exhibition type.

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CHURCHILL: STATESMAN, SOLDIER, AUTHOR, ARTIST

Lower, British Official

Sir Winston Leonard Spencer Churchill, K.G., world-famous as the man who led the United Kingdom to victory over Germany in the Second World War, has a wealth of natural gifts. In 1953 he was awarded the Nobel Prize for Literature, no less for his magnificent oratory than for his achievements as a writer. An Honorary Royal Academician, he is seen in the upper photograph painting at Marrakesh, Morocco. In the lower picture he is with President F. D. Roosevelt (centre) and Mackenzie King, Canadian premier, at the Quebec conference in 1943.

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was also introduced, and has since been crossed with one from Korea to give the dainty "Korean" varieties.

The name chrysanthemum comes from two Greek words meaning "golden flower," probably because the "single" varieties have golden yellow centres. Chrysanthemums belong to the daisy family, *Compositae*, therefore each so-called flower is really a mass of tiny flowers, and each so-called "petal" is a flower.

About 180 kinds or species grow wild in Europe, Asia, Africa, and North America, and from these hundreds of varieties have been produced by "crossing" or cultivation.

Most garden and greenhouse chrysanthemums are perennials—that is, they live many years. Very few seeds are made, especially by the double kinds, but new plants are grown from cuttings. If the grower hopes to produce new varieties, however, he must rely on seeds. The gay annual kinds with white, yellow, and brown or red rings round the "flower" came from crossing a North African species with the corn marigold, *Chrysanthemum segetum*, which grows wild in Britain and looks like a golden yellow ox-eye daisy. The ox-eye daisy itself is a wild chrysanthemum, *C. leucanthemum*, and the third English wild species is the feverfew, *C. parthenium*, which got its name as a supposed cure for fever. It is a roadside plant with many daisy-like flower-heads on each stem. Insecticides (powders which kill insects) are made from a Dalmatian and a Persian variety of chrysanthemum by drying the flowers, and from the pyrethrum plant, which some botanists say is actually a chrysanthemum.

Churchill, SIR WINSTON LEONARD SPENCER (born 1874). It was June 4, 1940, and a dark, fateful hour for Britain and for the whole civilized world. Within a few short weeks the armies of Nazi Germany had swept over Norway, Denmark, Holland, and Belgium; they had smashed through the thin defences of their opponents; whole armies had capitulated to them, and the British army had been driven from the European continent, losing all its weapons and equipment, and narrowly escaping utter annihilation. The whole world waited for the next shattering blow. Would it be directed at Britain? And if so, would Britain also find herself overwhelmed by this all-conquering enemy? It was indeed a gloomy prospect.

Then suddenly a voice was heard speaking—the voice of a man the country had learned to trust because he seemed to have been the one politician who had foreseen the full danger of war and had warned his fellows to meet it. It was the voice of the new prime minister, Winston Churchill.

Even after war had broken out and he had been taken into the government, there had still been times when this man alone had seemed to understand the seriousness of the situation. Then, less than a month earlier, he had been called to be prime minister and to form a government of men of all parties, pledged to more vigorous waging of the war. To those whom he had appointed to office he had said: "I have nothing to offer but blood, and toil, and tears, and sweat." And now at this moment of crisis he spoke, first to Parliament, and later the same day—using the same memorable words—by radio to all the anxious, angry people of Britain:

> We shall not flag or fail. We shall go on to the end, we shall fight in France, we shall fight on the seas and oceans, we shall fight with growing confidence and growing strength in the air. We shall defend our island whatever the cost may be. We shall fight on the beaches, we shall fight on the landing grounds, we shall fight in the fields and in the streets, we shall fight in the hills. We shall never surrender. . . .

Leader of a Nation

These stirring words were not just a statement of policy. They were a clarion call to the whole nation, and just the kind of call it had been hoping to hear. Never has a leader reflected more completely the mood of a people than Winston Churchill in 1940; he spoke both *to* them and *for* them. From that moment the British raised their heads and began the long, determined march to ultimate victory. It was a task which took almost five more years, during which Churchill remained the nation's trusted leader and inspired spokesman, and became one of the world's outstanding figures.

His immense energy and driving force, no less than his sagacity as statesman and strategist, were major factors in the successful waging of the war by the Allies. His duties as a war leader took him to important conferences in the U.S.A. (three times), Moscow (three times), Quebec (twice), Cairo (three times), Casablanca (North Africa), Teheran (Persia), Tunis, Athens, and Yalta (U.S.S.R.). And it was his honour and pride to announce to the British people, on May 8, 1945, that victory over Germany was at last achieved.

Winston Churchill was a grandson of the 7th Duke of Marlborough. His father, Lord Randolph Churchill, was a leading Conservative politician in his time. From his mother, Jenny Jerome, who was an American, he inherited a strain of vigorous originality. After being educated at Harrow, young Churchill went into the army. He served as a subaltern on the Indian frontier, and then in 1898 was attached to the 21st Lancers in the campaign against the Dervishes in the Sudan, and took part in a historic and costly cavalry charge at the battle of Omdurman.

When the South African war broke out in 1899, he went to the front as a war correspondent. Captured by the Boers almost at once, he escaped within a month, then served for a time as a lieutenant of the South African Light Horse.

In 1900 he came home and started that long and brilliant political career which was to lead to the highest honours. He enjoyed many periods of popularity, but at other times his actions were strongly criticised. More than once he was temporarily out of Parliament by defeat at the polls. But there was never a time through more than half a century when his buoyant, challenging personality was not well in the public eye. He first entered Parliament as a Conservative, but soon transferred his allegiance to the Liberals. He was appointed to his first office at the age of 31. At 34 he entered the Cabinet, as president of the board of trade. Here are some of the other offices he held at different times after that: home secretary, first lord of the admiralty (twice), minister of munitions (in the First World War), war secretary, colonial secretary, and chancellor of the exchequer.

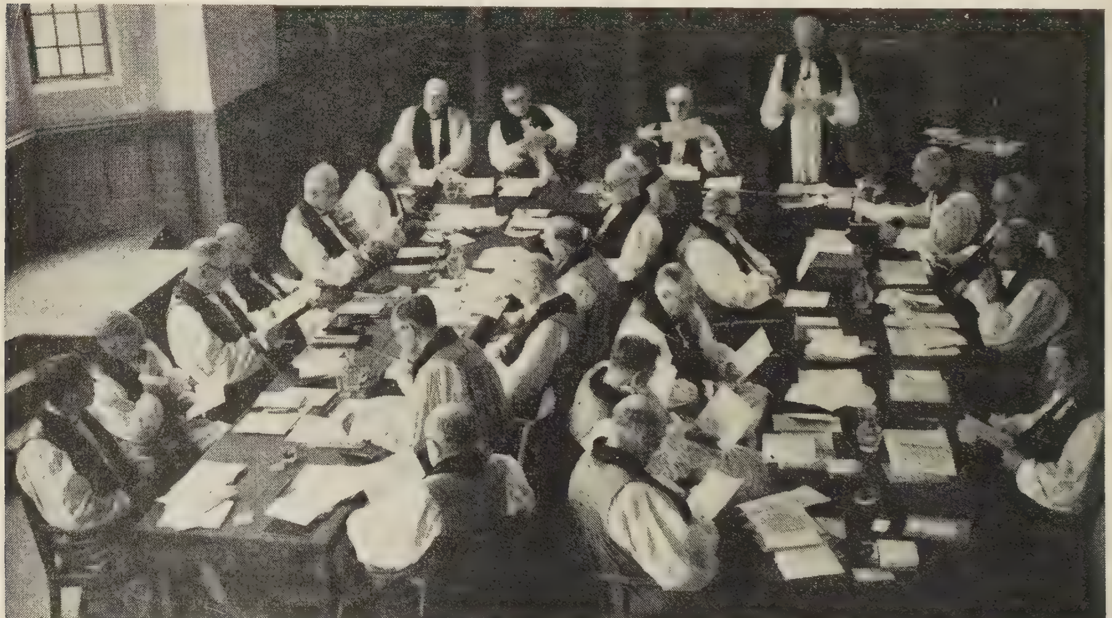
He rejoined the Conservative party in 1924, but from 1931 until the outbreak of the Second World War in 1939 he maintained an independent and critical attitude which led to his exclusion both from office and from the inner councils of the party. Then in 1940, soon after he became prime minister, he was elected the party's leader. In the election of 1945 the Conservatives were defeated, and Churchill thus became leader of the opposition until in 1951 he entered in his 78th year upon a second term as premier which lasted until his resignation in 1955. He was awarded the Order of Merit in 1946, and was made a Knight of the Garter in 1953.

As a writer, Churchill developed a style that is widely admired for its clarity and vigour as well as for its fine use of words. In 1953 he received the Nobel prize for literature. Among his books are biographies of his father and of his ancestor the 1st Duke of Marlborough; accounts of military campaigns; a collection of autobiographical sketches, entitled *My Early Life* (1930); *The World Crisis*, which will surely retain a permanent place among histories of the First World War; and his personal memoirs of the Second World War, in six volumes. After retirement he produced a four-volume *History of the English-Speaking Peoples* (1956–58), on which he had been engaged at intervals over many years. Taking up painting in 1915, he soon excelled, and was made Hon. Royal Academician Extraordinary in 1948. On his 80th birthday, in 1954, M.P.s of all parties paid affectionate tribute to this great man at a unique gathering in the historic Westminster Hall, where presentations were made.

Church of England. When people in England speak of "the Church," without any other description, they usually mean the state Church as by law established—in other words, the Church of England, or (as it is sometimes called) the Established Church. Its privileged position is shown by, among other things, the presence of its archbishops and some of its bishops in the House of Lords; and by its important rôle on such great occasions of state as a coronation. The Sovereign is legally the Supreme Governor of the Church of England, and at the time of a coronation the spiritual significance of this position is emphasised.

From the time of Saint Augustine, who became the first Archbishop of Canterbury, A.D. 601, to that of Henry VIII (reigned 1509–47), the English Church was in full communion with the Church of Rome. But Henry quarrelled with the Pope, and made the pronouncement that so far as his own dominions were concerned the Sovereign, not the Pope, was God's chief representative. In the reign of his son, Edward VI, the Book of Common Prayer was first authorised and published. This book—and particularly the thirty-nine "Articles of Religion" therein—still provides the basis of the faith of members of the Church of England.

The Church is episcopal, that is to say, governed by bishops, each in charge of a "diocese," or district. The Primate of All England is the Archbishop of Canterbury, next to whom in importance comes the Primate of England, the Archbishop of York. These dignitaries are each at the head of a "province" and also govern dioceses of their own. There are 41 other bishops and 43 suffragan (assistant) bishops in England. The Church in



UPPER HOUSE OF A CONVOCATION OF THE CHURCH OF ENGLAND

The official assemblies of the clergy of the Church of England are called Convocations. Each of the two provinces, Canterbury and York, has its own Convocation, consisting of two houses. Each upper house (above) is attended exclusively by the bishops of the appropriate province, with the archbishop presiding. The lower houses consist of deans, archdeacons, and at least three proctors from each diocese. The two upper houses form the House of Bishops, the two lower form the House of Clergy, of the Church Assembly.

Wales has its own archbishop and five other bishops; in Scotland, the Episcopal Church has seven bishops; and there are many others in dioceses oversea. The dioceses are subdivided into ecclesiastical parishes, each with its parish church, and each with its rector or vicar, the difference between the two being that the former receives *tithes* (annual charges payable to the Church since the 8th century, now in the form of rent charges) while the latter does not. A curate is usually an assistant to a rector or vicar. All clergymen must have taken holy orders, that is, must have been ordained into the ministry by a bishop.

H. Bastin

CICADA AT REST

Only one species of cicada is a native of England; and that is rare, being confined to the New Forest, Hants.

Since 1920, in addition to Convocation (see the illustration) there has been a Church Assembly, consisting of three Houses: Bishops, Clergy, and Laity. This can decide on alterations in forms of worship and in organization, but before any change can be made it must be sanctioned by Parliament.

Other offices in the Church are those of dean (head of the chapter, or clergy, of a cathedral or collegiate church), rural dean (parish clergyman acting as spokesman for the clergy of parishes in the deanery), canon (member of a cathedral chapter), prebendary (title now conferred as a mark of distinction), and archdeacon (two to four in each diocese, supervising business matters). Churchwardens are laymen, usually two in each parish, one appointed by the rector or vicar, the other by the parishioners.

Entry to the Church is by the rite of baptism, usually administered in infancy. But such baptism requires confirmation at an age when one is old enough to speak for oneself, the confirmation service being conducted by the bishop of a diocese. The Prayer Book says that "there shall none be admitted to the Holy Communion until such time as he be confirmed, or be ready and desirous to be confirmed," but individual modifications to this rule may be made at the discretion of the bishop.

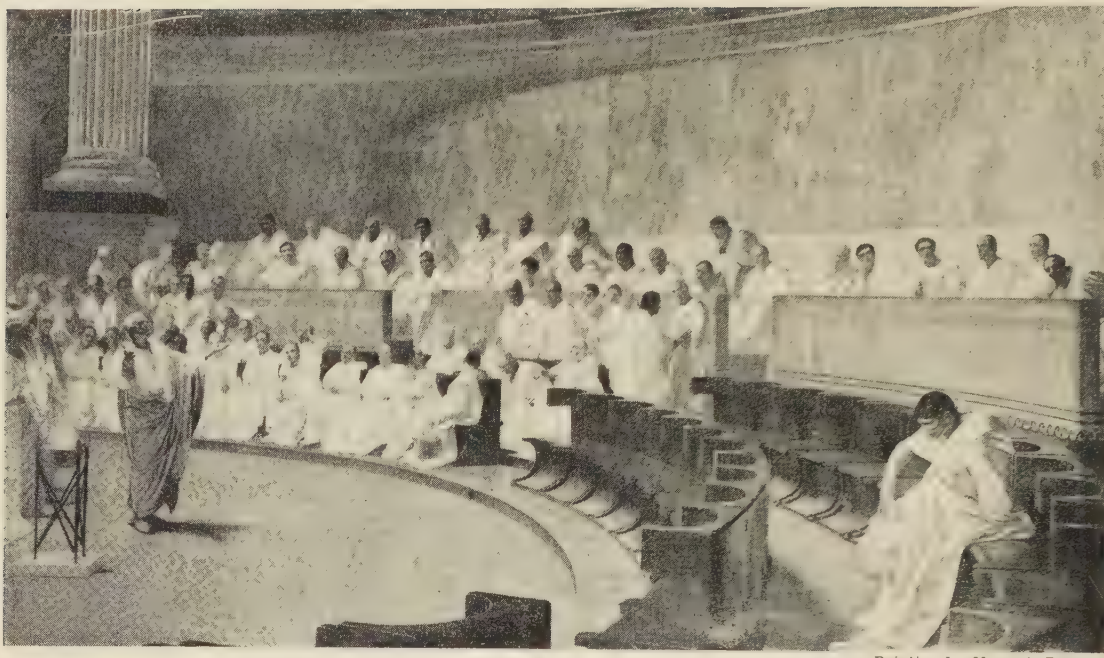
Church of Scotland. Church government through presbyters, men chosen by the various congregations and set apart for their twofold duties of teaching and ruling, with no variation in rank or status among them, was established in Scotland in 1590. By the Act of Union between England and Scotland (1707), the Church of Scotland, in this Presbyterian form, was acknowledged as a national Church; and one of the first acts of any new Sovereign of the United Kingdom is a reassertion on oath of the inviolability of this settlement. Other Presbyterian communities in Scotland have now become united with this national Church, government of which is maintained by kirk sessions, presbyteries, synods, and the General Assembly. This last, consisting of both clerical and lay representatives from each presbytery (there are 86 presbyteries), elects every year a "moderator" to preside over its meetings. The Sovereign is represented at those meetings by the Lord High Commissioner for the Church of Scotland, who is appointed for one year only.

Cicada (pron. sikā'da). These large four-winged insects belong to the order *Hemiptera* and are found in all warm countries. Several species occur in southern Europe, but only one is found in England (see picture alongside).

The 17-year cicada, *Tibicina septendecim*, is peculiar to the United States and appears in large numbers every 17 years. The nymphs, as the young are called, drop from the branches where they have hatched from eggs, burrow into the ground, attach themselves to roots, and remain there, sucking sap, until some years later, when they emerge into the light. They climb the trunk of a tree, their skins split, and out come the mature cicadas, to make the air resound for their few weeks of life with shrill, ear-piercing song. Only the males make the peculiar chirping sound, by means of drum-like plates at the base of the abdomen, which are vibrated rapidly by powerful muscles. The females are insect pests, doing great damage to forests and orchards by cutting rows of egg-pockets in twigs, causing twigs and leaves to fall off.

Cicero, MARCUS TULLIUS (106–43 B.C.). Orator, advocate, and writer, Cicero displayed in childhood such eagerness for learning that his father took him and his brother Quintus to Rome to study under the best teachers. In 91 B.C. he was awarded the *toga virilis* (the robe of manhood), continued his studies. and made his first acquaintance with philosophy. In 81 B.C. he was 26 years old, and delivered his first oration in the courts, in defence of P. Quintius. After several more successful court pleadings he went in 79 B.C. to Athens, partly to restore his jaded health and partly to pursue his studies under the leading philosophers of the day. In Athens he became a firm friend of Pomponius Atticus, another Roman. The friendship between the two men was such as to lead to a voluminous correspondence over years of separation. These letters, preserved for us by Cicero's freed-man secretary Tiro, are valuable documents giving detailed information on personalities, problems, and events of the time.

After two years in Athens, Cicero went back to Rome (77 B.C.). Returning to the forum, he became an outstandingly successful orator, winning verdicts for his clients as much by the compelling eloquence of his pleas as by the legal logic of his case. He was made quaestor (minister in charge of accounts) in Sicily in 75, and returned to Rome the following year, again being fully occupied with legal pleading. In the year 70 B.C. he distinguished himself by his impeachment of Verres for his intolerable extortions while in office in Sicily, which left the inhabitants desolated and ruined. Never was "the silver-tongued Cicero" heard to greater advantage than in the Verrine orations and in the orations condemning Catiline for his part in the conspiracy against the Roman state. In 63 B.C. he


Painting by Maccari, Rome

CICERO DELIVERING ONE OF HIS GREAT ORATIONS

Among the ancient Romans the art of oratory or rhetoric was cultivated more carefully than in modern times. Most famous of their orators was Cicero. He first displayed his powers in the law courts. But his greatest triumph came when he was 43 years of age and made a crushing indictment for treason against Catiline. This picture shows Cicero delivering one of his attacks in the Roman Senate. Catiline is sitting alone on the right, shunned by the other senators.

realized a long-cherished ambition by his appointment to the dignity of Consul.

Now began a difficult period of Cicero's life. He had reached the heights of power and his eloquence was sufficiently persuasive to lead the Senate well beyond the strict letter of the law. The man who, a few years before, had become " the Father of his Country " was now banished for the sins of the Senate, and his property was confiscated. Welcomed back the following year by a change in public favour, he was given a new residence. His re-entry into public life showed clearly the change of political fortune ; he now watched the gradual crumbling of the republic and the rise to power of Julius Caesar. Cicero decided to withdraw from public life. His wife left him and his beloved daughter died. To kill his grief Cicero retired to his study and wrote feverishly. His rhetorical works, seven in number, give his system of oratory and pleading. His philosophical works provide a finished vocabulary in Latin for abstract ideas. The texts of 56 of his orations survive. His letters are in three collections : (1) to and from his friends, (2) to his brother Quintus, (3) to Atticus.

Apart from his great services to his country in the forum, in public affairs, in the Senate, and in providing a philosophical vocabulary for the Romans, Cicero set a standard of strict honesty in public life which long survived him. He was ambitious, vain and changeable, occasionally self-pitying ; yet he was also a man of high ideals, generous, kindly, and capable of attracting friendship. He was the supreme master of Latin prose ; a poor poet, but a most eloquent conversationalist. Pursued by his enemies, he could have taken flight ; but he stayed to meet them, and was slain.

Cider and Perry. Cider is a fermented drink made from apples, and perry is one obtained from pears. In both drinks the fruit is pulped, and the juice that comes from it is run into vats. There it ferments, when the sweet ingredients of the juice are changed into alcohol, and so instead of plain apple or pear juice we have cider or perry. The best cider is made from a mixture of different kinds of apples, but the best perry comes from pears that are all of the same kind. The apples and pears from which cider and perry are made are too bitter to be of use for eating or cooking. Raw, unsweetened cider (called rough cider) is sour, but is a popular beverage in country districts. Large quantities of sweet cider are bottled for sale throughout Great Britain.

Most of the cider apples in Great Britain are grown in Somerset, Devon, Herefordshire, Worcestershire, and Gloucestershire. Perry is most commonly made in Herefordshire, Worcestershire, and Gloucestershire, where the drink is popular. Elsewhere, France is the most important cider-producing country, especially in Normandy and Brittany. Cider is also made in South Germany.

Cincinnatus, LUCIUS QUINTIUS (*c.* 519–439 B.C.). A model of early Roman integrity and frugality was Lucius Quintius Cincinnatus, a small farmer, who in 458 B.C. was called from his country retreat to become dictator and deliver Rome from the invading Aequians. This he did, with the aid of such fit young men as he could gather. Sixteen days later he gave up office and retired to his farm.

The American city of Cincinnati, Ohio, founded in 1788, takes its name from the Society of the Cincinnati, ex-officers of the War of Independence, who took Cincinnatus as their type and hero.

FILMS *and* HOW THEY ARE MADE

Cinema. A very old schoolboy trick is to draw on the outer page margins of a book a series of two very small "matchstick" figures going through the various stances and stages of boxing. One movement of the two figures is drawn on each margin, and when the pages are allowed to run quickly between finger and thumb the separate drawings follow each other so fast that the two figures seem to be engaged in a strenuous boxing match. Of course, this is only an optical illusion. It depends on the fact that the human eye retains an impression of each momentary scene for a short time after it has vanished, thus linking up all the separate pictures into one continuous action.

Drawing on page margins is not the sort of thing done by anyone who respects books, but the animated boxing match does illustrate what scientists call "persistence of vision." It is "persistence of vision" that makes us think we see a moving picture at the cinema, whereas we really see only a series of still photographs. A "moving" picture consists of many hundreds of separate photographs taken on one single film. When the film is projected on to a screen by being unwound in front of a bright light, the separate photographs follow one another at the rate of 24 a second, and any moving objects photographed appear to move just as naturally as they did when observed directly by the eye.

In the year 1824, Peter Mark Roget (1779–1869), a London doctor and scientist, delivered to the Royal Society a lecture on "persistence of vision," illustrating it with a series of drawings following one another in rapid succession. It was the schoolboy's boxing contest shown on a much bigger scale. His demonstration attracted a lot of attention, and various attempts were made to devise what were called moving-picture machines. One was the zoëtrope. This was a hollow upright cylinder with narrow slits in the side. Inside the cylinder was placed a strip of drawings showing a man in the various stages of running or jumping. The zoëtrope was twirled round swiftly by hand, and then, as one viewed the picture strip through the slits, the man appeared to be actually moving.

It was not until the development of photography that any attempt could be made to produce really convincing, life-like moving pictures. In 1870 an American named Henry Heyl used a magic lantern to project on to a screen a series of glass photographic negatives showing a man and woman waltzing. Another successful attempt to photograph and then project on to a screen the successive motions of a movement was made in 1881 by Eadweard Muybridge, an English photographer living in America. He arranged a row of 24 cameras, to the shutter of each of which was attached one end of a string, the other end being fixed in the ground some distance in front of the camera. A horse was then galloped past the cameras. As it trod on the strings, it caused the camera shutters to open and close one after the other. The films were then developed and observed through a zoëtrope. Later, with the French painter Jean Meissonier, he invented a method of projecting life-like moving pictures through a magic lantern.

CAMERAMEN AIDED BY A CRANE

In order to obtain a wider field of view and a position from which the camera can be focused at the most suitable angles, the cameramen sometimes make use of a camera suspended from the end of a crane. The apparent confusion is really part of an orderly plan.

The Muybridge-Meissonier moving picture was blurred and flickering, because the photographs were moved through the magic lantern by hand. But another English inventor, William Friese-Greene (1855–1921), hit on the idea of exactly timing the interval between the taking of each photograph and the one that followed it, and then having the same timing between their projections on to a screen. One night in early 1889, Friese-Greene dashed out of his house in London, asked a policeman to come inside, and showed the surprised constable a somewhat jerky picture of people and vehicles moving past Hyde Park Corner.

Up to that time all projectors had used single photographs, but in that same year the American George Eastman (1854–1932) took a series of photographs on a roll of film, which was then run through the projector. This idea was adopted by Thomas Alva Edison (see article), who used roll film in his "kinetoscope." A London maker of scientific instruments, Robert W. Paul, improved the kinetoscope by fitting clockwork mechanism.

ACHIEVING REALISM IN A BRITISH FILM

For the film *Captain Boycott*, scene builders constructed a replica of an Irish village in England. An " Irishman " with his donkey is waiting in the left foreground for his cue. On the right is the camera with the microphone above it. Neither expense nor trouble is spared in the attempt to achieve realism and accuracy in all details.

who had invented a camera using roll film and a projector called the *cinématographe.* In this, the spool of film carrying the still photographs was unwound by an electrically-driven clockwork device which stopped the film 24 times every second. This gave the audience time to focus each picture properly without destroying the illusion of movement, and further reduced blurring and flickering. In February 1896 the Lumières came to London and put on the first film show in Great Britain at the Regent Street Polytechnic.

Within a week or two a British machine built by Robert Paul was showing films at Olympia. In America, Thomas Armat invented a projector with an intermittent device, called the Vitascope—the forerunner of the projectors used to-day.

Early in the development of moving pictures it was realized that they would be even more effective if they could be shown in colour. Early experiments were made in colouring by hand each of the hundreds of separate photographs on a roll of film. But no method was really successful until the introduction of the " Kodachrome " film, in the 1920s.

This film is coated with three layers of emulsion (*see* PHOTOGRAPHY), and each layer contains a dye that makes it sensitive to only one group of colours ; that is, each layer will

So many inventors had been concerned with moving pictures in 1889 that for years afterwards no one could be quite certain who was the actual inventor of cinematography. Eventually the dispute was taken to court and judgment given for Friese-Greene. Although he had taken and projected moving pictures and had patented his process before Edison produced his kinetoscope, he had found no support for his invention and made no money from it.

Kinetoscope parlours were opened in New York in 1894, supplied with films from a studio built by Edison. In December 1895 the first public film show was opened in Paris by the Lumière brothers,

photograph only the colour of objects within the colour group of its dye. The top layer photographs blues ; the next layer, greens ; the last layer, reds. The developed reel of film becomes, in effect, a series of coloured magic-lantern slides.

The next great advance was the coming of sound towards the end of the 1920s. Silent films, which were usually presented to the accompaniment of appropriate music, were constantly punctuated by " sub-titles " providing patches of dialogue or commenting in some other way on the film. Sometimes various devices were used to imitate pistol shots or the galloping of horses. Sometimes gramophone records of speech and

[*Continued on page 413*

DEVELOPMENT OF MOTION PICTURE ART

THE PERIOD OF GREAT SPECTACLES

In this scene from *The Birth of a Nation* (1914–15) is to be noted the earliest form of cinematic grand spectacle. D. W. Griffith was the pioneer in this development of film technique, and his film had tremendous power. The wide range of the cinema camera had never before been so ambitiously used as in this film about the American Civil War, with its sweeping panoramic scenes, peopled, as a theatre stage could never be, with hundreds of actors.

A spectacle picture with a moral was *Intolerance* (1917), the second of the Griffith classics. It developed the recurrence throughout history of the spirit of intolerance among men, and it used the same bold technique in production as was used in *The Birth of a Nation.* There were huge, dominating close-ups and swift cross-cutting from one episode to another. Such elaborate scenes as this representation of ancient Babylon helped to make the picture memorable.

From a script by H. G. Wells, the film *Things to Come* was produced by Alexander Korda in 1935. The British film industry had suffered a long period of depression, yet here was a production of startling originality and power, by which film audiences were transported far into the future, to a world that has forgotten war, a world of fantastic beauty, in which human enterprise and courage were diverted to high ideals of service and sacrifice.

In contrast with, yet in some ways strangely like, the British film of fantasy was the stark expressionism of *The Cabinet of Dr. Caligari*, a German film of 1919. Here was the presentation of a world as seen by a madman. The skilful use of strange angles, shadows, distorted perspectives, and scenes of great beauty was intensely effective. This " expressionist " technique, using symbols rather than realism, is still sometimes seen to-day.

CHILDREN STEALING THE PICTURE

Adult actors and actresses often find children playing in the same cast give such wonderfully natural performances that they themselves appear to be somewhat mediocre. Two films in which child actors endeared themselves to the audience were *Raising a Riot* (above), and *Smiley* (picture on left). Colin Peterson, young Australian star of *Smiley* is on the right. This boy came to England in 1957 to play the chief part in *The Scamp*, in which he scored a big success.

other sounds were played behind the screen, but it was rarely that the sounds coincided correctly with the appropriate actions on the film. The problem of "synchronising" sound and action was not solved until it became possible to record both at the same time and so to project both at once.

The method used to-day is as follows. While a scene is being photographed, the sounds are picked up by a microphone (see article) through which an electric current is passing. Changes in the strength or pitch of the sound cause changes in the strength of the current, which is converted into a beam of light shining through the slit of a light-gate on to the edge of the film in a sound-camera. A light-gate is a device which instantly responds to changes in the intensity of the beam of light passing through it, so that the width of the slit increases or decreases according to the strength of the light beam; therefore the light

Kodak, Ltd.

STRIP FROM A SOUND-FILM

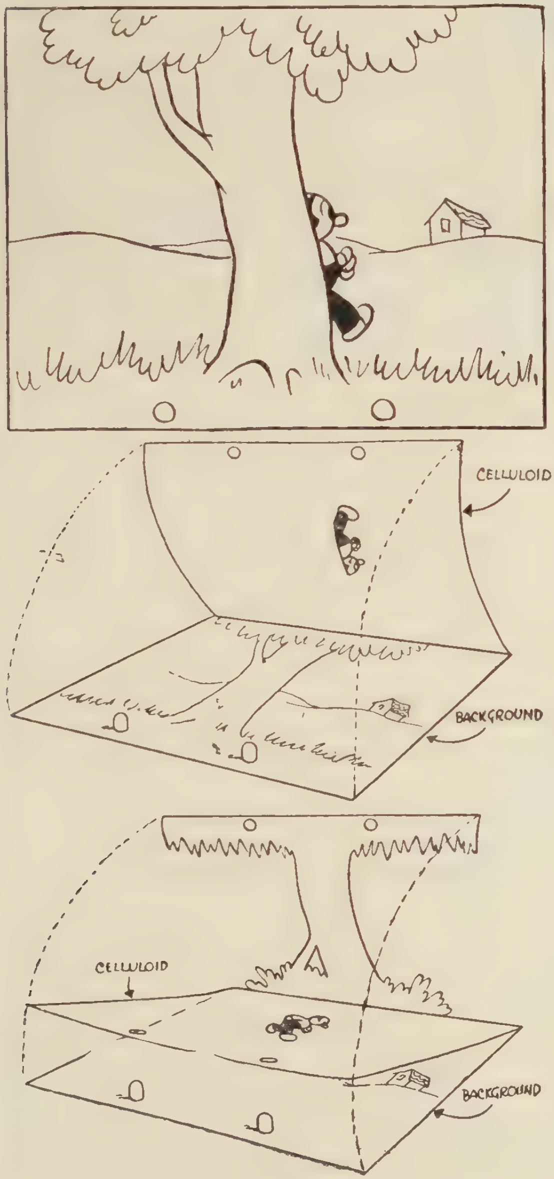
This strip from a talking picture shows scenes which will be thrown on the screen, with the sound-track on the left. While pictures are being taken, the dialogue is recorded separately, and is later combined with music and sound effects to form the final sound-track.

falling on the moving reel of film draws lines of varying thickness. The sound-film is developed in the ordinary way and is then printed with the film of the action part of the picture; the result is a single film with the sound-lines at the side of the action pictures.

When the film is run through the projector, a beam of light shines through the sound-track on to a photo-electric cell (*see* PHOTO-ELECTRIC DEVICES), which turns the varying thicknesses of the light-beam into an electric current of varying strength. The current then goes to a loudspeaker behind the screen, where it operates a microphone which changes the current back into the correct sounds.

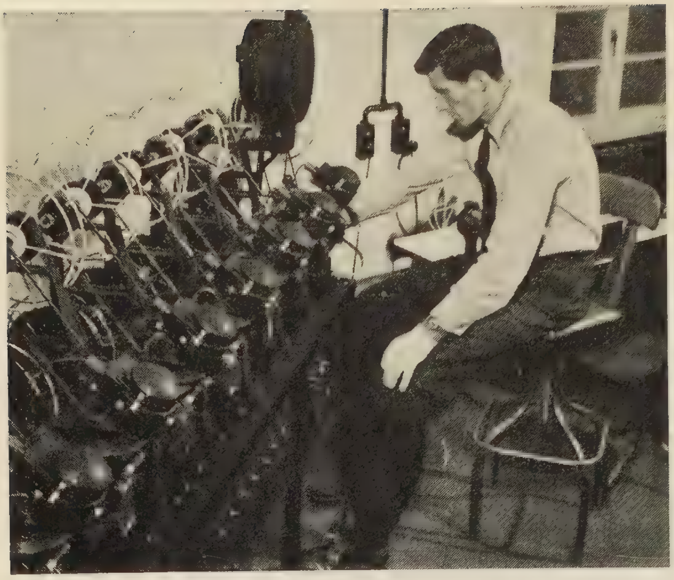
The first sound-film, called *The Lights of New York*, was shown in that city on July 6, 1928.

How is a film play produced and photographed at the present time? A script is prepared for the producer, showing on one side of the page the action in each scene, and on the other, the words to be spoken, as well as other sounds which may



THE MAN AND THE TREE

In film cartoon work (left) there are two ways of moving a character across a static background without redrawing the whole thing for every camera shot. The scene at the top, for instance, can be worked out as shown in centre diagram—by flapping over the figure drawings against the tree, which stays still; or as in lower diagram, by flapping the tree down over the man. The holes are for the register pins, keeping the celluloids superimposed.



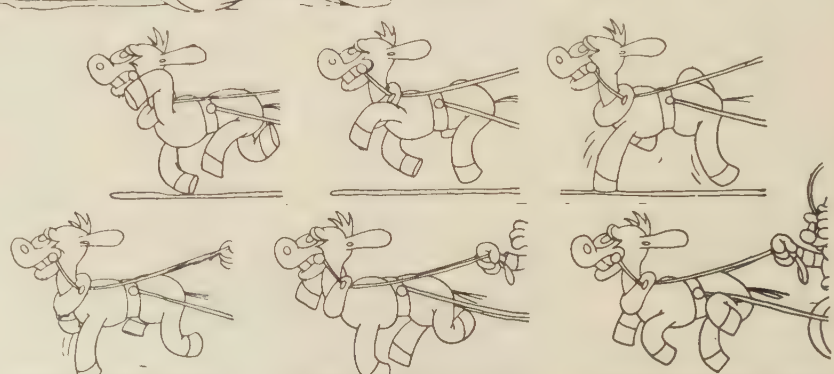
COLOURED CARTOON PRODUCTION

In the cutting room the cutter is synchronising the pictures and sound track on a movieola—a special projector which allows the film to be stopped or turned back as required for any particular scenes to be examined again. Only a small screen is necessary for this job.

be necessary. The script may be that of an original play specially written for filming, or an adaptation of a novel or a stage play. The script is then "broken down," the scenes being grouped and listed according to their settings. Thus all the drawing-room scenes can be shot while the camera is on that set, and so on. A schedule is prepared; dress charts are got out; there are endless conferences with the art director who builds the sets. Models may be needed —perhaps models of ships for a sea battle, or a model of a village which will save the building of a big outdoor scene. Scenes in streets or the countryside may be specially shot so that they can be projected on a screen in the studio later, while actors play their parts in front of them, to give the effect of being out of doors.

When the script is finally approved by the producer, the production unit will be chosen and all the actors and actresses engaged. Under the producer, the chief members of the production unit are the director with his assistants, and the lighting cameraman with his camera crew.

Finally the day arrives when shooting on the first set begins. Imagine yourself walking on the studio floor with the director. It is a little after nine in the morning. An outer door leads into a sort of air-lock, and then a second heavy sound-proof door into the studio. Lights are burning high up near the roof, which together with the walls is covered with thick padding to stop echoes, which would spoil the sound recording. The members of the cast are dressed and made up. Plasterers, carpenters, painters, electricians, and scene-shifters bustle about. In the middle of the set stands the lighting cameraman giving orders to the electricians for the lighting of the set. "Spot that 2K. Kill No. 5. Let me have a pup about here, please." These are the curious names given to various types of lights. Behind him the camera is being lined up for the first scene. It is a large, heavy object on a massive wheeled carriage called a "dolly" and has a sound-proof cover to cut out the noise of its electric motor. As the lighting cameraman steps back, satisfied with his lighting and the director steps forward to begin his work, his first assistant turns to a man sitting with headphones on at a control panel. "Bell, please." The man presses a switch. Bells ring inside the studio and outside. Red lights go on. A hush falls on the



ANIMATING RAPID MOVEMENT

At the top is a finished drawing of a cart racing on to the screen in *Sam's Medal*. Below is a series of drawings for the horse, in sequence. At top left is a key man's drawing; the others are by "in-between" men. All work as a team.

SHOOTING AN OUTDOOR SCENE IN SUNSHINE

This scene from *Penny Princess*, which was filmed in Spain, shows that arc lamps are often needed to supplement even the brightest sunshine. If the script calls for a scene to be taken in the rain, then everyone must be prepared for a soaking. The filming of one particular sequence may take only a few minutes or as much as five hours.

studio, and as the scene is rehearsed and then "shot," it will be seen that just as the camera follows the players, so a microphone, suspended on a long arm above their heads, follows them, too.

Eventually all the thousands of feet of picture film and sound track are printed and reach the editor. He can identify each picture scene and its accompanying sound track by their numbers and knows where each one begins by its mark. He has machines called movieolas or editolas through which he can run these pieces of film and sound-track. In this way, he assembles and cuts the film, choosing everything to best effect.

Finally all these tracks are put into the right order by the editor and "mixed" or re-recorded by the sound recordist into one complete sound-track carrying voices, sound effects, and music. At last there is one complete length of film.

Now all the negatives from which the pictures and sound have been printed are sorted out, cut, and joined together to match this original. Once this has been done, as many copies as are needed can be made from the negative, all carrying on one film, the photographed action and the recorded sound-track. The picture is ready for its first public showing.

There is another kind of film-making quite as remarkable, for which no sets are built and no bells rung to enjoin silence. This is the world of Mickey Mouse, Donald Duck, and others, of the advertising cartoon film and the animated technical or instructional film. Here the story is worked out as a series of sketches pinned up on a story board. From these an artist makes a number of key drawings. Another artist, called an animator, makes a series of drawings for the characters who appear in each scene. His drawings show them at various stages of the action. More artists, called "in-betweeners," make further drawings to complete the animation of each of these characters, so that finally there will be dozens of drawings to show how each character moves.

Each man has in front of him a chart marked in one column for voice and music, and in other columns for the movements of characters. The animators must, of course, work strictly as a team, so that a character drawn by one man must be exactly the same personality as his colleague is drawing at the next desk. All these drawings are then traced on to sheets of thin transparent plastic (called "cells" because they were first made from celluloid), and painted in colours. Other artists will have meanwhile completed the backgrounds against which the characters will appear. To photograph these drawings a special camera is used, mounted in a framework with the lens pointing straight down towards a rigid table on which the drawings are placed and held flat. Both

In the upper picture a love scene in a costume play is being acted before a studio-built wall and doorway. The audience will see only the two lovers and the fake background. Performing under the eyes of director, producer, and technicians is very trying, and the heat from the lamps is terrific. The woman writing is the "continuity girl." The lower picture is of a stage scene which is a replica of a provincial music-hall.

the framework holding the drawings, and the camera can move in various directions. First the background is placed in position—on top of this goes a " cell " showing the character's body and face—on top of this another " cell " showing, say, his arms and legs in the first position. One single frame of film is exposed. Then the top cell is removed and another one replaces it showing the arms and legs in the next position. Another photograph is taken. So it goes on. Each one of these photographs which appear on the screen at the ordinary projection speed of 24 a second is taken separately.

But the cinema is more than a technical achievement : it is a form of art. From its earliest days the power of the film to present fantasy and comedy by the use of ingenious camera tricks was recognized. In France, Georges Méliès produced *Cinderella* in 1899, *A Trip to the Moon* in 1902, and many more films, ingenious, fantastic, and comic at the same time. But their influence on others was not marked. It fell to Edwin Porter, a director working for Edison and his associates, to set the standard. In 1903 he made *The Great Train Robbery*, a straightforward story of how a gang of thieves held up and robbed a train. This simple film established the power of the screen to tell in terms of action and expression a strong, simple, dramatic story.

In those early 1900s Great Britain and America were rivals for the lead, and, if anything, Britain lay ahead. But a combination of genius and favourable circumstances gave the lead to America and there it has remained ever since, despite the fact that important film industries and several great producers are to be found nowadays in Great Britain, France, Italy, and elsewhere. The genius was of two kinds, the drive and vision of men like Adolph Zukor, who founded Paramount Pictures, and Carl Laemmle, who built Universal City near Hollywood, and the mastery of the new medium shown by men like D. W. Griffith and Cecil B. de Mille.

Early Spectacular Films

Griffith made his first films as early as 1907, but his great successes were from 1913 onwards, when the American film industry was well established in Hollywood, and the example of Adolph Zukor, Jesse Lasky, and Cecil B. de Mille had proved that lengthy pictures with strong dramatic themes could make a great deal of money. Cinema theatres were springing up right and left—a great market was coming into being. So Griffith was able to give full rein to his genius for handling great themes, enormous masses of people, and moments of high drama. Films like *The Birth of a Nation* and *Intolerance* burst upon audiences everywhere with a force and power that shocked them. The vivid, clear development of the story, the telling use of close-up, the building of suspense, the sweep of the whole affair, in these things Griffiths proved himself a master.

There were many in America willing and able to learn from him, and there were others great in their own right like de Mille and Chaplin. In Europe, production of films virtually stopped during the First World War. Money poured into Hollywood, and the era of the great stars of the silent film began. Hollywood became a great factory turning out mass entertainment. Much of it was raw and crude, but the impetus to improve was never lost. The film never lost the dramatic power it had discovered so early, and it progressed towards some wit and polish and delicacy.

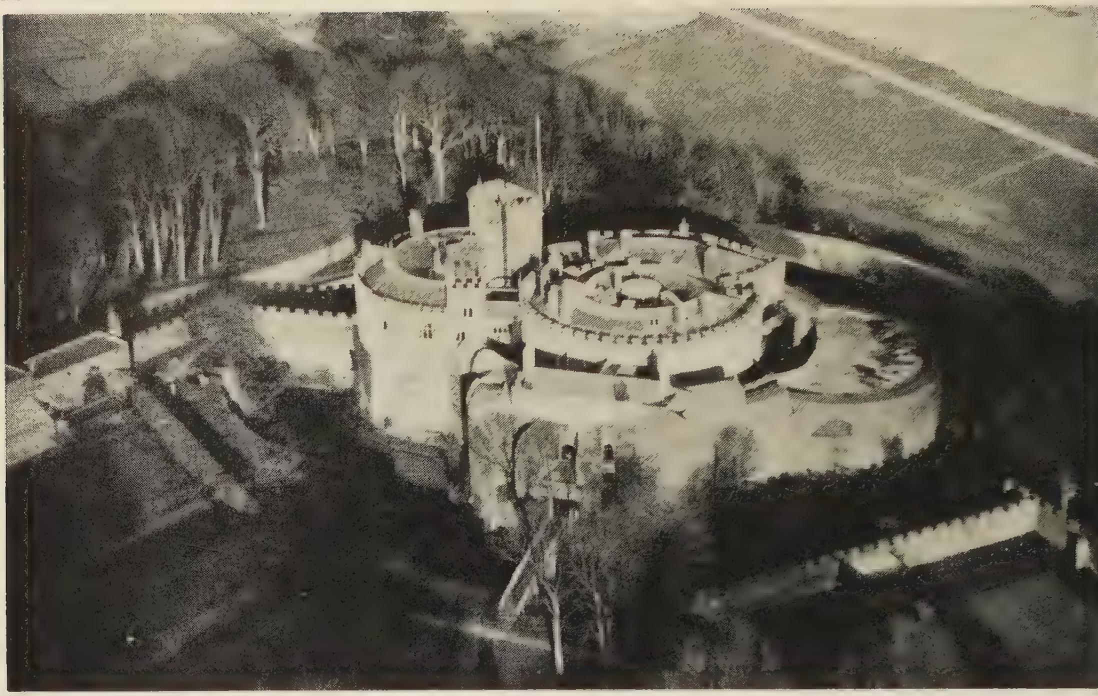
As Europe recovered from the exhaustion of war, films of some significance began to be made there again. The films of Germany, cynical, futuristic, or pessimistic, reflected the mood of a defeated and impoverished nation. In France and in Britain in the 1930s films began to be made which had some native flavour and were meritorious because in many ways they reflected the thought and mode of life of the countries in which they were made. In Russia a new and powerful school of film makers sprang up after the Revolution, bent on using the medium for propaganda, and with original ideas on the editing of films and the use of musical scores ; chief among them were Pudovkin and Eisenstein.

The Talking Picture

The coming of sound produced a temporary halt in the advance of film as an art form. The camera became immobilised in a sound-proof booth and the essentially mobile nature of screen art was lost for a time. But this was soon overcome. From Hollywood a stream of screen adaptations of famous plays began. There was a general rise in the level of its stories. Though some regretted the passing of the silent screen, it was probably more than compensated for in the opportunity given by sound to employ great players from the stage, and great writers and playwrights. Influenced perhaps by the people making films in Europe, and by the many able writers and directors brought from all parts of Europe (men like Lubitsch, Erich von Stroheim, and René Clair), American films began to take more account of the world around them. Many of them began to have much in common with life as it is lived by ordinary people. The film developed a social consciousness.

In Great Britain there was a special movement which went farther in this direction. The documentary movement grew up, devoted to making films about real people—how they work, how they live, what it is like to go out with the herring fishers in the North Sea, to ride on the night mail to the North, or to work in a coal-mine. This " creative interpretation of reality," as John Grierson called it, produced a school of British film makers who were able to take full advantage of the challenge of the Second World War. This impetus remained after the war. Though there have been financial difficulties once more, Great Britain has made, and is making, her own special contribution to the film art of the world. The same is true of France and Italy, where the experiences of the war, particularly of the Resistance movements, had a stimulating effect.

One other great function of the film needs to be mentioned, its vast and increasing use as a medium of information and instruction exclusively. In the schools thousands of specially made films are screened every year, teaching geography by showing other lands, their products and peoples, teaching science and history and a vast range of other subjects, helping to enlarge the experience



WALMER CASTLE, OFFICIAL RESIDENCE OF THE LORD WARDEN

The Lord Warden of the Cinque Ports is also the constable of Dover, by virtue of his appointment as admiral of the ports, and his official residence is Walmer Castle, which is situated about 3 miles south of Deal. The original building, which was constructed in 1539 as a blockhouse, has since been much altered and enlarged. The chief duty of the Cinque Ports was to provide men and ships for the navy, and in return they were granted many special privileges.

of the young. Films train people in factories and in the services, films show the people of many lands how to till their farms better, how to fight disease, how to avail themselves of the increasing knowledge and well-being which science and good government can bring. Such films spread knowledge, information, enlightenment, culture, and hope. This is an unspectacular work, accomplished without glamour or advertisement. It is perhaps the noblest thing that films can do.

"Three-Dimensional" Films

Ordinarily a picture projected on the screen is flat, like a snapshot; you cannot see behind the characters or objects as you can in a play on the stage. Moreover, the action or scene is always something seen at a distance. It is rather like looking at the moon through a powerful telescope. The observer has no feeling that he is actually *on* the moon.

Attempts have been made to adapt the stereoscope (see article) to the cinema with the object of making the scenes and objects appear what is called three-dimensional, that is, "in the round." A stereoscope does this successfully with single snapshots, but becomes very complicated when several hundred people have to view the same picture. One method is to provide every member of the audience with stereoscopic spectacles. Another is to use a camera having three lenses, each of which records one third of the scene being shot. The three films thus obtained are then simultaneously projected, each from its own projector, on to a concave screen.

One of the most successful three-dimensional film systems, the raster, uses only one projector, but the white screen has in front of it a second screen consisting of hundreds of pairs of cone-shaped lenses. Each pair of lenses acts as a stereoscope, so that as the picture is projected objects in the foreground stand out from the background. But once the viewer has focused the picture through a pair of lenses in the front screen he must not move his head, otherwise the illusion of depth is lost.

The use of a very wide, curved screen gives some illusion to an audience of being in the middle of the scene on a film. It is not stereoscopic, but gives an illusion of depth as the picture almost surrounds the audience to provide what is called "peripheral vision," *i.e.* seeing out of the corner of the eye.

Cinque Ports (pron. sink). Those who know some French (*cinque*, Old French for five) would expect the Cinque Ports to be a group of five; and so, in their earliest origins, they were—the ports of Hastings, Romney, Hythe, Dover, and Sandwich. In the 13th century Winchelsea and Rye were added, and at various times more than thirty places were included, so that the company of ports extended along the whole south-east coast from Margate (Kent) to Seaford (Sussex); but these were all "limbs," or subsidiary ports, the first seven being "head ports." Some of the Cinque Ports like Rye and Winchelsea are now inland towns because the sea has moved back.

The Cinque Ports association was formed soon after the Norman Conquest in 1066 from a loose confederacy that had already been in existence

for some time. Its chief duty was to provide men and ships for the king's navy, and it received many valuable privileges—each port sent two representatives to Parliament; all the ports were exempt from taxes; they had their own courts of law; and their trade was free of tolls. They lost most of these privileges in 1688, and the remainder in 1835.

The Lord Warden of the Cinque Ports is also the constable of Dover Castle, as the admiral of the ports, and his official residence is at Walmer Castle. He still has the right to appoint justices of the peace. The appointment to the ancient office of Lord Warden of the Cinque Ports is nowadays a reward for service to the nation. Famous lord wardens include the 1st Duke of Wellington and Sir Winston Churchill.

Circe (Greek pron. kēr′kā anglicised as sê′sē). In the *Odyssey* of Homer appears this famous sorceress who, by means of drugs and spells, had the magic power to turn men into swine and other beasts. She was the daughter of the sun-god Helios and of Perse, an ocean nymph. For killing her husband she had been put by her father on the beautiful island of Aeaea. Odysseus and his companions were driven on to the shores of the island by a storm. Odysseus did not know that it was the home of Circe, and seeing smoke rising from a wooded hill, he sent Eurylochus with half his men to learn who dwelt there.

In the wood they found a gleaming marble palace, guarded by tame lions and wolves which fawned upon them like dogs. Within sat a lovely, fair-haired lady, weaving at her loom and singing sweetly. With kind words and charming manners Circe invited the strangers into her palace.

The others went, but Eurylochus, fearing treachery, stayed outside. Within the shining doors she made them a meal of cheese and barley-meal and yellow honey with wine, and mingled baneful drugs with the food to make them utterly forget their own country. When they had eaten, the sorceress presently smote her guests with her wand, and they were instantly turned into swine. They had the shape and voice and bristles of swine, but their minds were unchanged. She drove them into pigsties and flung them acorns to eat.

Eurylochus, horror-stricken at the sight, fled to Odysseus and told him the dreadful news. Drawing his sword, Odysseus strode alone through the charmed wood to the palace of Circe. The enchantress welcomed him and gave him the magic drug in a cup of gold. But when she had smitten him with her wand and saw that he did not turn into an animal, she fell on her knees, thinking him a god. Never before had mortal man withstood her sorceries. In truth Odysseus was protected against her magic by the flower of the moly, a plant sacred to the gods. Hermes (Mercury), the messenger god who wore winged sandals, had overtaken him on the way and given him the flower.

Unable to bewitch Odysseus, Circe turned her arts to his service. She changed his comrades back into men; and by her kindness she so wrought upon them that they dwelt there for a year, while she entertained them with every sort of luxury and pleasure. In her palace she "rocked the tedious year as in a delightful dream." The only thing she refused her guests was their freedom to leave.

At last, because Odysseus became melancholy with longing to see his wife and son, she consented to let him depart. But first she told him how to descend to Hades, the land of the dead, so that he might learn his fate from the seer Teiresias. When he came back in safety, she stocked his galleys with bread and meat, warned him of dangers that lay before him, and told him how he might avoid them. Then, standing on the shore with her nymphs, she bade him a sad farewell.—*Retold from Homer's Odyssey, Books X and XII.*

From the picture by Briton Riviere, R.A

CIRCE CHANGES HER GUESTS INTO SWINE

According to Greek mythology, Circe was an enchantress who lived on an island. When Odysseus and his companions were cast ashore on Circe's island, she changed all but Odysseus into swine, by means of her magic wand. Odysseus himself, fortified by an antidote given him by Hermes (the messenger of the gods), escaped the transformation and remained on the island for a year, at the end of which time Circe allowed him to continue his voyage.

Circus. "Here we are again!" cries the clown as he somersaults into the ring of the Christmas circus; and he might add: "after 2,300 years!" For the first circus was a level space in the valley between the Palatine and Aventine Hills (two of the seven hills on which Rome is built) where the legendary Roman king Tarquinius Priscus gave his people a show of races and fist-fights to celebrate his capture of the town of Apiolus from the Latins. This was in the 4th century B.C. The spectacle so pleased the Romans that a permanent building was erected on the site of Tarquin's games, a long oval with tiers of seats, resembling a modern stadium or football ground but able to hold about twice the number of spectators that can be accommodated at Wembley Stadium. This was called the Circus, later the Circus Maximus (greatest circus) to distinguish it from three other Roman circuses: the Circus Flaminius, built in 221 B.C., the Circus Caligula, afterwards called the Circus Neronis (of Nero), and the Circus Maxentius, built in A.D. 311.

Here were held the games which were ancient Rome's chief form of entertainment. The most important events at first were the chariot races. The Circus Maximus was 1,875 feet long and 625 feet wide. Down the centre of its oval, sanded arena (so called from the Latin word, *harena*, for sand) ran a wall, the *spina* (backbone), and round this were driven the chariots drawn by two, three, or four horses, in races of seven laps. At each end of the *spina* were groups of columns to mark the turning points, and on these were seven large marble balls at one end and seven stone dolphins at the other, one of which was removed after each lap. Alongside or ahead of each chariot rode a single horseman. His functions were to encourage the chariot horses, to clear the way, and to indicate to the charioteer where best to steer. These riders and drivers became in later years professionals, wearing the colours of one of four teams representing the seasons: green (spring), red (summer), blue (autumn), and white (winter). The spectacle was thrilling in the extreme, and bets were laid throughout the race. The thunder of the hoofs, the shouting of the spectators and of the bookmakers, the crash of overturned chariots, the dust rising in clouds in the hot sunshine, added to an atmosphere of feverish excitement.

The Roman Holiday

It became the custom for returning conquerors and newly enthroned emperors to vie with one another in presenting ever greater and more expensive spectacles to the people. To chariot-racing was added during the Second Punic War the exhibition of wild animals brought back from conquered countries: at first elephants captured from the Carthaginians, then lions from Africa; later, as Rome's conquests extended, bears, panthers, and an occasional rarity like a rhinoceros, giraffe, or tiger. Originally merely shown in cages, as in a menagerie, the animals later became an object of sport, and were slaughtered in their thousands "to make a Roman holiday." The emperor Hadrian had one thousand animals killed on his birthday; Commodus is said to have killed several thousand with his own hand; Gordian planted a "forest" in the Circus and turned into it 200 stags, 30 wild horses, 100 wild sheep, 10 elks, 100 Cyprian bulls, 300 ostriches, 30 wild asses, 150 wild boars, 200 ibexes, and 200 deer, then invited all who pleased to come in and hunt and slaughter what they wanted. Later the animals were set to fighting one another. They were enraged with whips, fire, liquor, and coloured cloths, and a horrible spectacle resulted. Men called *bestiarii*, mostly condemned criminals, also fought the animals to the death. Later the gladiators killed one another to amuse the bloodthirsty mob. At Julius Caesar's games 800 gladiators were engaged in mutual slaughter. Caesar also staged "naval" battles by flooding the arena and having boatloads of men fight one another.

Bread and Circuses

As the Roman empire declined and fell, the people became more and more greedy for free shows and free food, and to prevent revolutions the emperors had to provide them. *Panem et circenses* (bread and circuses) formed one of the chief causes of the degeneration of the Roman character and the final collapse of the Empire. But the tradition of the circus lived on through the Dark and Middle Ages into modern times, and, cruelty apart, a goodly number of the basic items of the circus of to-day go right back to the chariot-racing, trick-riding, and wild-animal shows of ancient Rome.

During the Middle Ages two further ingredients of the modern circus came into being: these were, first, a large class of wandering entertainers—*jongleurs*, trainers of dancing bears, tricksters and conjurers of all kinds—and, second, the village fair. At the fair, held sometimes to celebrate a saint's day, sometimes at the conclusion of a successful harvest, and yearly for the hiring of new farm servants, the entertainers, tricksters, and pedlars came together to make a "day out" for Everyman. At a higher level of society the medieval joust and tourney between armoured knights drew the crowds—and the minstrels, troubadours, and glee-men to entertain them. Later, royalty visiting some noble castle would expect a pageant to be provided, and spectacular novelties of all kinds were sought after to amuse bored monarchs and their courts.

By the 18th century entertainment in England had become an industry. In London great fairs at Smithfield, Southwark, and Mayfair (where the May Fair was held) attracted enormous crowds of the lower orders, while later the "Gardens" of Vauxhall, Cremorne, and Ranelagh amused the wealthier folk with song and dance, tight-rope walking, balloon ascents, and other excitements. A highly popular spectacle was trick-riding on horseback, a form of entertainment that goes back to the Roman circus, where the *desultor* (rider who leaps from horse to horse) was a popular figure. Riding-masters set up their enclosures all round fashionable London, or were engaged by the keepers of taverns and tea-gardens for the amusement of their patrons.

One riding-master and trick-rider, who had lived with horses all his life, and had served in the Dragoons and in Frederick the Great of Prussia's cavalry, was Sergeant-Major Philip Astley. He came to London in 1776 to set up a riding-school

THRILLING DISPLAYS IN THE CIRCUS RING

The circus has been a popular form of entertainment in the United Kingdom for over 150 years, and is still an enthralling spectacle, especially for children during the Christmas season. As spoken words usually form no part of the display, circus performers are drawn from all nations. These riders, performing at Olympia, London, are English, and perform amazing feats.

Most people like tame elephants, and as performers they are firm favourites with circus audiences. These six, which execute intricate tricks with an engaging air of slightly outraged dignity, are trained by a Swede. Though circuses are not as common as they were before the First World War, some memorable shows have been staged since 1920 at Olympia, London.

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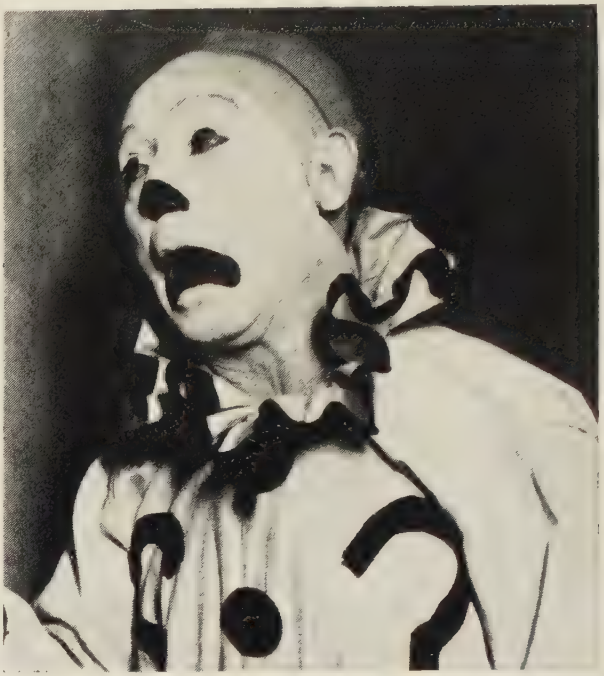
BIG PARADE AND ATTENDANT CLOWNS AT THE CIRCUS



Clowns, with their grotesque make-up and costumes (upper photographs), are an essential part of the circus throughout the world. They amuse the audience during the Big Parade (lower photograph) and between the various displays. The ring in the arena is the one in which Liberty horses and other trained animals perform, and equestrian acts are displayed. It has a diameter of 42 feet, which is the standard measurement in all countries.

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for the gentry, and in order to raise money for this venture gave shows on a piece of ground which he rented on the south bank of the Thames between Westminster and Blackfriars bridges. To begin with, the show comprised trick-riding by Astley and his wife, and the exploits of a learned horse which could count, answer questions, and fire a pistol. So successful was Astley that in 1778 he built an enclosed " ring " called the Amphitheatre Riding House, and two years later he began to engage additional acts—more riders, tight-rope and slack-wire walkers, ladder balancers, jugglers. The building had both a circular arena and a stage, so that it combined the features of both Roman circus and Greek theatre ; but the London theatres obtained a ruling that no spoken dialogue was to be allowed, so that it was entirely in the direction of spectacle that the circus developed. Even to-day, except for a few jokes by the clowns and the announcements of the ring-master, the entertainment is entirely for the eye.

Astley died in 1814, and his circus passed through several ownerships until in 1868 it was bought by " Lord " George Sanger, the first of modern English showmen. Sanger's Circus occupied Astley's during the winter, and in the summer took to " tenting " round the countryside ; but in 1893 Sanger had to sell the building on the south bank and it was pulled down, after nearly 120 years of successful entertainment.

Barnum and Bailey's

By then many famous Victorian circuses had come and gone : there were Hengler's, Cooke's, Myers's, Ginnett's, Fossett's, and others, and there were visits from the great American circuses. The circus of to-day owes a great deal to the famous American showman Phineas T. Barnum, who began by exhibiting an elderly Negress who was supposed to be the nurse of George Washington, and ended by producing " the greatest show on earth," an enormous three-ring circus with performers brought from all over the world, freaks and wild animals of every conceivable kind, including the famous elephant Jumbo.

Barnum and Bailey's, bought in 1907 by the Ringling Brothers, is the greatest name in American circus history. In England the nearest equivalent of modern times is Bertram Mills, who started a tenting show after the First World War and annually at Christmas put on a lavish show at Olympia, London. Though Paris has three permanent circuses, in London there is no all-the-year-round show, and the summer-time tented circus is the best-known form. The Tower Circus at Blackpool has the largest season on one site, providing entertainment for the whole summer holiday period ; but to most of us the circus is the " big top " that grows mysteriously out of the ground overnight, gives us thrills and laughs for a few days, then vanishes in a night again. This is the living relic of a great history : when the clown cries " Here we are again ! " he means by " we " the Roman charioteer and gladiator, the medieval minstrel and *jongleur*, the bear-leader of Shakespeare's day, Mr. Astley standing on his head on the back of a horse at full gallop, Mr. Barnum showing Tom Thumb to Queen Victoria, and a cascade of Grimaldis, Grocks, and Whimsical Walkers who have thrilled and amused the world, both young and old, for twenty-three centuries.

Civil Service. Almost all the employees of government departments apart from the armed forces are included in the Civil Service, which to-day ranges from boy and girl clerks to high dignitaries like the permanent secretary of the treasury (the head of the Civil Service), from the postmen on the pavement to the Director of the British Museum. These people are servants of the Crown (excluding judges and Members of Parliament) whose salaries are paid directly out of money voted by Parliament. Almost every profession and trade is represented in the Civil Service; there are doctors, lawyers, architects, accountants, writers, printers, bricklayers, gardeners, as well as thousands of clerks.

Government officials are as old as government itself. In Greece of the 5th century B.C. there had already grown up an efficient organization of officials, each with his particular duties. The judges, who also presided over ceremonies, were called *archons*. There were two classes of tax-gatherer, the *tamiai* (treasurers) and *apodektai* (receivers-general of revenue). In addition Athens had a police force (*astunomoi*) and a department which looked after street repairs (*hodopoioi*). These and other officials were all chosen by lot to serve for one year only, and had to pass an examination for "worthiness" called the *dokimasia*.

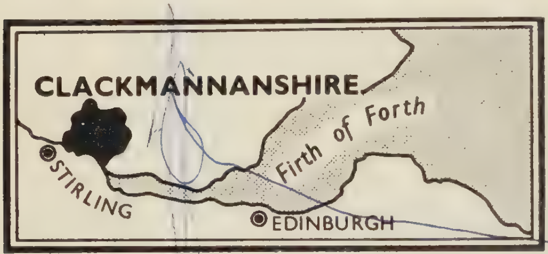
In China of the 2nd century B.C. there was a large civil service chosen after examinations in literature (including writing verse), history, music, and archery. To keep his post a Chinese civil servant had to pass his examination again every nine years ; the prime minister, who was the highest official, had in his first nine years of office to beat all comers in an examination every three years. There were 25 grades of official. The rank of those in the nine highest grades (the mandarins) was indicated by a coloured button on top of the hat and a badge on the robe. The departments of government were organized in much the same way as to-day. There were boards of foreign affairs, home affairs, finance, law, education, and ceremonial, all with their head offices in Peking.

A large civil service was needed for the administration of the Roman empire. Every provincial governor had his organization of clerks and tax-gatherers. In Rome itself the *aediles*, elected by the people, had charge of temples, buildings, streets, markets, games, and, at first, the corn supply. The *quaestors*, elected annually by the people, were at first detectives employed in tracing criminals, but later had charge of the treasury, collecting taxes and paying out public money. They, too, employed many scribes, or clerks (the poet Horace was one of these for a short time). Another important class of official was formed by the *censors*, who supervised the conduct of people and senators and also had duties in connexion with public works contracts, tax collection, and the letting of state lands. They were elected every five years.

In the United Kingdom the choosing of civil servants by means of examinations did not begin until 1855 in the case of junior staff ; it was extended in 1870 to all classes of official. Before

then appointments had been by patronage. There are to-day three chief grades of civil servant: (1) clerical; (2) executive, with a high grammar-school standard of education; and (3) administrative, with a university degree standard. The attraction of the Civil Service to many is that it is "secure" employment; once established, a civil servant is not dismissed except for a grave misdemeanour, and a pension is paid after retirement. In Great Britain civil servants do not change with governments; whatever the party in power in the House of Commons, the permanent officials continue in their offices in Whitehall. In some countries a new government may dismiss civil servants appointed by a former government in order to give posts to their own supporters. In the U.S.A. this was formerly the general practice, but to-day only the highest grades of official are affected. The stability of a country greatly depends on the honesty, ability, and experience of its permanent officials. In this respect no country is better served than Great Britain. (*See* CAREERS.)

Clackmannanshire. Competing successfully in both cricket and commerce, Clackmannanshire, the smallest county in the British Isles is called "gallant." Situated in the central lowlands of Scotland, its length is nine miles, its breadth ten, and its area 34,927 acres. Bounded on the north by Perthshire and the Ochil hills, containing the summit Bencleuch



(2,363 feet) meaning "stony mountain," the county slopes southwards to the Firth of Forth, crossed by its tributaries the rivers Devon and Black Devon. Stirlingshire lies on the west, and Fife and Kinross on the east. Although Alloa (population 13,436) is the chief burgh, the county town is Clackmannan (3,022). The name is of Gaelic origin, *Clachan-Mannan* meaning the village of the ancient Mannan district at the head of the Forth estuary. Other towns are Alva, Dollar, and Tillicoultry. Sheep-farming, coal-mining, woollen manufacturing, and brewing and distilling are some of the prosperous industries which make Clackmannanshire one of the wealthiest Scottish counties for its size. The population is 37,528.

Clan (Gaelic *clann* or *clanna*, children). "Victory or death!" This was the war cry of the MacNeills, one of the Scottish Highland clans. These family groups are first mentioned as existing in Scotland and Ireland under the rule of a chief in the 11th century. They had the bond of a common surname and the belief that they were descended from the same ancestor. The system existed in many parts of the world, for example in Mexico under the ancient Aztecs (*see* article).

But in general the word relates to the Highlands and Western Islands of Scotland. In those far-off days it was natural for the different communities in the glens to band themselves together, under the bravest man among them, to protect their possessions. Such a man became their chief. He was regarded as the ruler and landlord, holding the land not for himself but for the benefit of the clan. He possessed his own estate which passed to his successor. He also led his people in the violent battles which were not uncommon in the Highlands. The members of the clan adopted the same name, which was either the name of the chief or of the district in which they lived. The chief also had a special name or title inherited by his successor.

Every large and powerful clan had attached to it smaller clans or septs, as they are called, having different names but joined together by blood relationship. The successor to the clan chief was chosen from a group of his nine nearest kinsmen. Official recognition of clan names and chiefs is made by a special court in Scotland called the Court of the Lord Lyon King of Arms; and Acts of Parliament have been passed safeguarding the use of coats of arms and crests belonging to the clans. Each clan has its own distinctive tartan, the chequered design used for the plaid and kilt (*see* TARTAN colour plate in Vol. 7).

The ancient chiefs had their own personal attendants, among whom were a bard to sing the beautiful Gaelic songs and boast of the importance of the clan, and a piper to play the bagpipes and inspire the warriors when going into battle. In order to call all his clansmen together to a meeting the chief would send out a runner bearing a fiery cross, formed of two pieces of wood nailed together. One end was burned with fire, the other dipped in the blood of a slaughtered goat.

The clan system flourished in Scotland for six centuries until it was destroyed at the end of "the Forty-five"—the unsuccessful rebellion of the Jacobites (see article) in 1745 headed by "Bonnie Prince Charlie." In his attempt to regain the Scottish throne he enlisted the help of many clans, but was defeated finally at the battle of Culloden in 1746. From this time forward the clan system, under which the chief had been father of his people, began to come to an end. All arms had to be surrendered. To wear the kilt or play the bagpipes was regarded as treason. Many of the Highland people were forced to leave their country, and the land which had belonged to the clans came to be looked on as belonging to the chiefs. Nevertheless the clan spirit remains to this day in the comradeship of clan associations which still bind the clansmen together in loyalty to their chiefs.

Clay. Everyone knows clay as the sticky stuff that clings to shoes when one walks through a ploughed field or along a country lane on a wet day. (The word comes from the Old English *claeg*, meaning "something sticky".) It is one of the commonest things, occurring in almost every country of the world; and since earliest times man has made use of it in many ways. Centuries ago he discovered that clayey soils were good for crops, that mud huts kept out the rain, and that clay-lined ponds would collect water for his flocks. He found out that clay, mixed with water, could be moulded into pots and jars which, when heated, became hard and stone-like. He made writing tablets from slabs of wet clay, which he inscribed with a

bone tool. When baked, these were much more durable than modern writing-paper, and examples can be seen in the British Museum.

And yet no one has succeeded in saying exactly what clay is, in language acceptable to all the modern experts in the subject, though much research has been carried out on clays of all types, using up-to-date techniques like X-rays, thermal analysis (*i.e.* analysis by heat), the electron microscope, and detailed chemical analysis. Much has been revealed, but still more remains to be discovered about this amazing substance, which has played so big a part in human life that writers have often referred to it as the basic stuff of creation—as in the old carol which speaks of Adam as being made " out of the dust and clay."

It will be sufficient here to say that clay is a general term for a wide range of earthy substances that have been formed by the weathering, or chemical decomposition, of former rocks. When found in the place where it was originally produced, clay is called residual (*i.e.* " that which remains ") ; when washed out by rain-water and re-deposited elsewhere, as for instance in the bed of a river or lake, or carried out to sea and deposited on the ocean bed, it is said to be sedimentary. The distinction is important, for the two types of clay usually have different properties. Thus, for instance, the china-clay deposits of Cornwall are residual, but the ball-clays of Devon and Dorset are sedimentary, though containing the same clay mineral as china-clay. The ball-clays are much more plastic—that is, capable of being moulded to a required shape—and contain more impurities.

Clays are composed of extremely small particles, and are usually mixtures of one or more " clay minerals," rock-forming minerals, and other substances. There are numerous clay minerals, and they are chiefly compounds of water, aluminium, and silica, often with other things added.

The principal types of commercial clay include : *Common clay*, used in large quantities for making bricks, tiles, cement, and concrete ; *Fireclay*, or *refractory clay*, capable of withstanding high temperatures, and used for furnace linings, backs of fireplaces, etc.—this is often found under coal measures (see illustration to the article on COAL); *Stoneware and pottery clay*, used for earthenware, stoneware, crockery, and glazed ware ; *Ball-clay*, so-called because it is dug out of the quarry in cubes or " balls " about 10 inches across—this is used to make pottery mixtures more plastic (*see* POTTERY) ; *China-clay* or *kaolin*, used in the manufacture of paper, pottery, etc. (*see* CHINA-CLAY) ; *Fuller's earth*, formerly used to remove oil and grease from cloth, but now more used for bleaching and clarifying oils, fat, greases, etc., and for other purposes ; *Bentonite*, a peculiar and interesting clay derived from volcanic ash, some varieties swelling enormously when wetted and becoming a gel (*see* COLLOIDS for definition)—used for oil-well drilling-muds, and as a bond for moulding-sands ; *Bauxite*, from which the metal aluminium (see article) is obtained.

Malby; Hortiphoto

CLEMATIS IN FLOWER AND SEED

There are many shades of colour in varieties of garden clematis, and flowers (left) vary in size. Those of the wild clematis (traveller's joy, or old man's beard) of Britain are small and greenish-white, followed in autumn by masses (right) of seed vessels with feather " tails."

Some clays, especially fuller's earths and non-swelling bentonites, are sometimes treated with acids, steam, etc., and they are then called activated clays. They have plenty of industrial uses ; for example, in the refining of oils and fats, when the minute clay particles are able to hold on to certain chemical impurities.

Devil's Mud is an unusual clay from Cyprus. It is called by this sinister name because of its destructive action on miners' clothes. It owes its value to its gold and silver contents.

" Firing " or " burning " is the process by which pottery, tiles, bricks, etc., made from clay are heated to a high temperature. The clay becomes hard and stone-like and can no longer be softened by water. The minerals in the different clays determine their colour when fired. Burned clay resembling stone is used by architects and sculptors under the name of " terra-cotta," meaning baked earth. In Spain a glossy kind of " terra-cotta " in vivid colourings is used for decorating the outsides of buildings.

Clematis. Climbing over trellis arches and other supports, the garden varieties of clematis open their silky " petalled " flowers in summer, giving masses of white, purple, violet, or pink colour. The name in Greek means brushwood or kindling wood, and that is what the withered, slightly woody stems look like in winter. Clematis is the only climbing member of the buttercup family, *Ranunculaceae*, and the plant is held up by the slender leaf stalks of the compound leaves (*see* LEAVES) as they curl round supports. Most of the garden varieties come from Japan. Clematis flowers have no true petals, but the sepals are " disguised " as petals. Nor is there any nectar, but the bees, attracted by the scent, gather pollen

from the tuft of stamens in each flower. The seedcases are clustered in the centre, and when they ripen they become first dark red, then brown, each growing a long white, silky plume to be wafted away by the wind. These plumes look rather like white beards.

Old man's beard, or traveller's joy, growing wild over country hedges particularly on chalky soil, is *Clematis vitalba*. Its flowers, about ¾ in. across, have four greenish-white sepals and smell like hawthorn. The plant is poisonous to cattle if eaten in large quantities. Baskets to carry light articles are made from the thicker stems.

Cleopatra (69–30 B.C.). Upon the death of her father, Ptolemy XIII Auletes, in 51 B.C., Cleopatra (pron. klēōpat'ra), then 17 years old and already noted for her beauty, was appointed joint ruler of Egypt with her younger brother. Three years later she was ousted from the throne, but was reinstated by the intervention of Julius Caesar. Picture the conquering Roman, seated in a room in the citadel of Alexandria, Egypt. Two slaves enter, bearing a magnificent rug.

"Cleopatra, Queen of Egypt, begs Caesar to accept this gift," says one of them.

Very gently they put their burden down and unroll it, and out springs none other than Cleopatra herself.

CLEOPATRA, QUEEN OF EGYPT
This portrait is taken from a sculpture at Dendera, Egypt. She was not, in fact, an Egyptian, for the dynasty of the Ptolemys, to which she belonged, was Greek.

Dazzled at the sight of such loveliness as he had never before seen, the stern warrior surrendered to the charms of Cleopatra, and helped her to crush her foes and slay her brother.

In 44 Caesar fell under the daggers of conspirators at Rome. Mark Antony, who had triumphed in the war which followed and had become ruler of the eastern half of the Roman Empire, summoned the lovely queen to appear before him to answer charges that she had helped his enemies. She went, not as a penitent, but as a proud queen, sailing up the river Cydnus in Asia Minor, where Antony then was, in barbaric magnificence. Shakespeare describes how—

> The barge she sat in, like a burnished throne,
> Burn'd on the water; the poop was beaten gold;
> Purple the sails, and so perfumed that
> The winds were love-sick with them; the oars were silver;
> Which to the tune of flutes kept stroke.

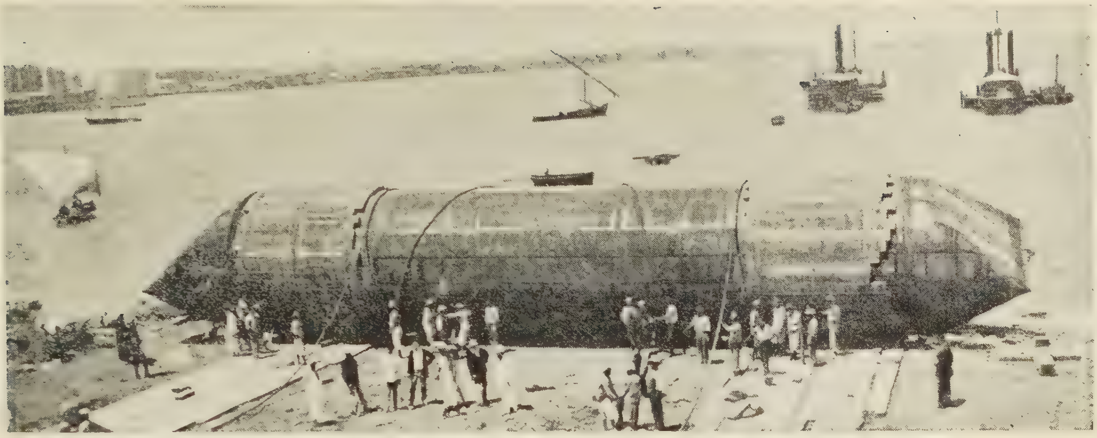
Like Caesar before him, Antony lost his heart and his head. Forgetting his wife and the high duties he owed to Rome, the warrior now became Cleopatra's willing slave. Balked of her hopes of ruling Rome with Caesar, the Egyptian queen now dreamed of accomplishing her ambitions as Antony's consort. But the end was not long in coming. Antony's foes at Rome prevailed on the Senate to declare war on this dangerous woman. A sea battle was fought in 31 B.C. off Actium, a promontory of Acarnania on the coast of ancient Greece, and the queen, seized with panic, fled with her ships. Antony followed her, deserted by his troops, and from being master of half the world became a hunted fugitive. For the last time Cleopatra exercised her powers of fascination on Antony's conqueror, Octavian, who was so soon to become Augustus, the first Emperor of Rome. But Octavian was made of sterner stuff than Antony, and was proof against her blandishments. Antony soon after killed himself. Cleopatra, proud and queenly to the last, rather than go to Rome in chains, ended her life—so the story goes—by letting a poisonous asp (snake) bite her. Her personality and dramatic story have always attracted writers; she is the heroine of Shakespeare's *Antony and Cleopatra* and Shaw's *Caesar and Cleopatra.*

Cleopatra's Needle. By no means "just another monument," Cleopatra's Needle is older than any building in London, and has had a varied and exciting history. It is 68½ feet high and weighs 180 tons.

This massive granite column, called a needle because of its pointed top, was hewn from the quarries at Syene, near the modern Assuan on the Nile, Egypt, hauled by slaves to the river, down which it was floated, and then hauled again to the court of King Thothmes III of Egypt and set up to glorify the sun-god about 1475 B.C. at his capital, near Cairo, which we know by its Greek name Heliopolis, the City of the Sun.

Later Rameses II had his own story carved on one of its faces; and under Augustus (12 B.C.) it was transferred to the Caesareum at Alexandria. Here it stood for over 1,500 years before it fell. Lost sight of until 1801, it was unearthed by the British general Sir Ralph Abercromby, who before his death expressed a wish to have it taken to England to commemorate his victory at Aboukir Bay. He and his friends actually subscribed £7,000 for this purpose, but it was not until 1877 that the work was carried out. In the meantime it was offered in 1820 to George IV as a coronation present by Mehemet Ali and refused.

For transport to England the monument was enclosed in a huge cylinder, and given a keel and



CLEOPATRA'S NEEDLE BEGINS ITS EVENTFUL VOYAGE

In this large steel shell Cleopatra's Needle journeyed to England in 1877. Here it has been brought down to the water's edge at Alexandria, and close to the shore are two paddle tugs waiting to take it in tow. It was lost during heavy weather in the Bay of Biscay, but was eventually taken in tow by a British ship and brought to London

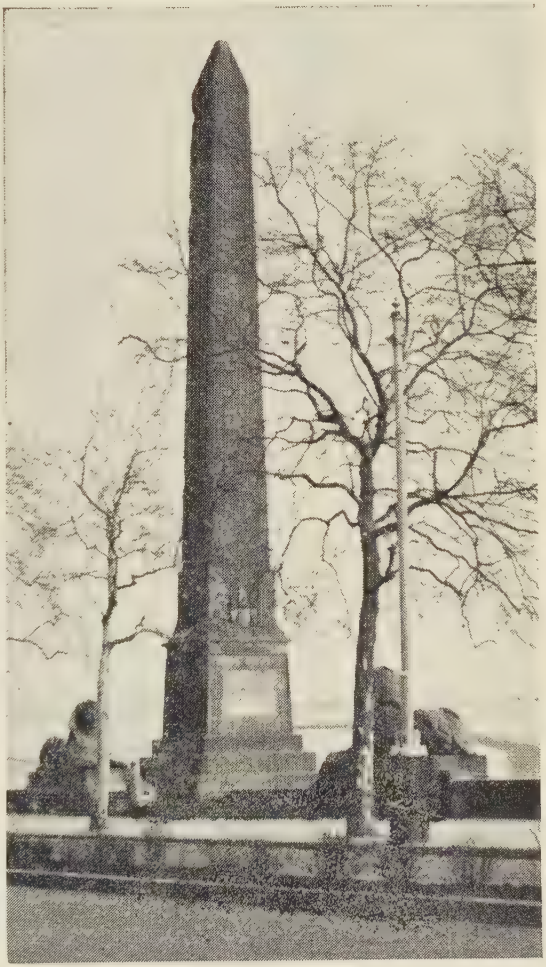
rudder, and a deck and cabin for a crew of six. Before being launched, it fell into a prehistoric tomb, and then, after being towed into the sea by tugs, struck a rock and sank. After being raised and repaired, it was taken in tow, but in the Bay of Biscay had to be cut adrift on account of heavy seas. It was discovered by a British vessel, and finally reached England. On September 12, 1878, it was erected on the Victoria Embankment, London. On September 4, 1917, during the First World War, it was chipped by a fragment of a German bomb. In 1879 a similar monument, the fellow of the London one (for Egyptian obelisks were generally set up in pairs) was taken from Alexandria, to which it had been removed in Roman times, across the Atlantic to New York. It was shipped in a steamer by opening a port in her bows, and was erected in Central Park in 1881.

Climate. By far the most important outward influence upon life on the earth's surface is climate. It is the dominating factor in determining the animal and plant life of every region. Broadly speaking, it is climate that settles where men live and how they get their food, clothing, and shelter. In short, it has controlled and continues to control to a great extent the development of the whole of human civilization.

No wonder, then, that the first thing to do when studying a country and its people is to find out the kind of climate they have. But before one can understand the climate in a single region, one must know something about the elements that make up climate in general.

The principal ones are the same wherever you are—temperature, moisture, sunshine, and wind. The amounts of each and the way in which they are combined vary to a surprising extent.

Temperature, the most important element in climate, is also the one which is distributed over the globe with the nearest approach to regularity. The earth is belted with a hot zone in the middle and wears ice caps on the poles, because the greatest amount of heat is received where the sun's rays fall perpendicularly, as at or near the equator, and the least amount where they fall with a wide slant over a wide area, as at the poles.



CLEOPATRA'S NEEDLE

Erected in 1878 on the Victoria Embankment, London, between Waterloo and Charing Cross bridges, this obelisk had been hewn in Egypt about 1475 B.C. Called a needle because of its pointed top, it is $68\frac{1}{2}$ feet high.

WORLD'S WETTEST—
No other place on the earth's surface cares to challenge the unenviable record held by Cherrapunji (picture to right), a hill-station in Assam—that of being the wettest spot in the world. The average annual rainfall is 424 inches, this area enjoying virtually no dry season throughout the year. But the rains moderate the temperature, so that even in summer it ranges round 84° F.

—AND DRIEST
By contrast, rain is virtually unknown in the Gobi desert of Central Asia (left-hand picture), a vast barren region of sand, where the camel is the only practicable means of transport. Lack of rain here is due to two factors: first, the distance from the sea, which is thousands of miles away in any direction ; and the flatness, with no mountains to trap the clouds.

But other conditions besides latitude affect temperature. Mount Cotopaxi, almost on the equator in Ecuador, is capped with snow, yet the uplands of Ecuador produce wheat and other temperate-zone products. Sunny Italy lies more north than equally sunny Tibet, yet Tibet is so high that its climate is harsh and its nights and winters are almost unendurably cold. In general, temperature decreases about one degree Fahrenheit with every rise of 300 feet above sea-level.

Still another factor in determining temperature is situation in relation to water areas and to the prevailing winds. The sea has a milder and more even climate than the land, because, while the land absorbs the sun's heat rapidly and radiates it just as quickly, large bodies of water acquire heat slowly and spend it sparingly. Land near the water—still more, land surrounded by water—has the benefit of this conservation of warmth, particularly if the prevailing wind should be towards the shore.

Nearly all of western Europe has a milder, more even climate than most of North America, which has what is called a continental climate. The very compact North American continent excludes the ocean's influence, while western Europe, mainly composed of peninsulas, invites the ocean breezes, and so enjoys what is known as an oceanic climate. The moisture factor of climate depends on winds and local conditions. Winds may be water-drinkers or water-carriers ; and the water-carriers may not drop their loads unless forced to do so by mountains. A cool wind, gradually heated in its course, like the Etesian winds that blow from the Mediterranean over the Sahara, develops a raging thirst that parches the land over which it blows. A warm wind laden with moisture from the ocean, on the other hand, will deliver most of its load on reaching a mountain, being cooled by expansion as it rises, and thereby causing the condensation of the vapour it carries. Such are the winds that bring the winter rains on the Pacific coast of North America. Heavy rainfall or snowfall almost always characterises the windward side of high mountains, while the other sides are frequently regions of comparative drought.

Sunshine in its full intensity follows the sun's track, of course ; yet tropical regions bordering on the sea have comparatively little sunshine during their rainy seasons. Only over inland deserts are the tropical skies entirely cloudless.

There is a greater amount of sunshine, in general, towards the equator than towards the poles ; in the interior of continents than on the coasts ; and in summer than in winter. Yet the longer

summer day which enables Alaska to raise wheat and strawberries compensates in some degree for the smaller amount of total sunshine.

Variability is an extremely important aspect of climate. It makes all the difference in the world whether you get your allotted heat, moisture, sunshine, and wind all in one dose, so to speak, or spread out evenly through the day and the year. Take temperature: the warmest month in Quito, the capital of Ecuador in South America, is only one degree warmer than the coolest; but the warmest month in Yakutsk, northern Siberia, is 100 degrees warmer than the coldest. As for moisture, the British Isles receives rain (or snow when it is too cold for rain) throughout the year, but the greater part of the sub-continent of India gets virtually all its rain during the months of the summer monsoon (May to September).

There are certain broad classifications for climate. The student should not be misled by maps in which the globe is neatly belted with torrid, temperate, and frigid zones, bounded by parallels of latitude. These boundaries do not correspond to climatic facts, for the heat equator strays far north of the geographical equator and the annual isotherms (or lines showing how far the same average temperature prevails) play leap-frog all round the parallels of latitude. Moreover, the temperate zone is seldom really temperate, but is a region in which climate varies a great deal from place to place.

If we call our main climatic belts tropical, subtropical, intermediate, cold, and polar, perhaps we shall come as near to accuracy as a broad classification can, particularly if we remember that annual isotherms and not parallels of latitude are the boundaries, and that mountains, continents, oceans, and lesser variations of surface introduce endless variations within each climatic belt.

Human beings manage to live with varying degrees of success in almost every variety of climate except that of the polar regions; but most animals and plants are less adaptable. Hot and moist climates produce the luxuriant tropical forests with their elephants, monkeys, cockatoos, and myriad other forms of wild life; they give us such plants as coffee, sugar, pepper, and bananas. Hot and dry climates produce the cactus, agave, and date palm.

Tea, rice, cotton, wheat, maize, olives, figs, and grapes are products of climates furnishing moderate heat and moisture, though some require and some cannot endure high summer temperatures; while some tolerate and others perish in low winter temperatures. Regions with summers ranging from 50° to 72° Fahrenheit produce hardy grains and the fruits which are most tolerant of cold. The polar zones produce little plant life beyond mosses and lichens, but within the Arctic circle is a luxuriant growth of summer flowering plants. (*See* GEOLOGY; METEOROLOGY; WEATHER.)

Clive, ROBERT, LORD (1725–74). About 1744 a poor, friendless young clerk in Madras tried to shoot himself, but the pistol failed to go off. Thirty years later, still under 50 but broken in health and distressed in mind, the former clerk again took up his pistol—and this time it worked. It sounds a melancholy story, yet between those extremes was lived a life of power and success; a life that scored a deep mark on history: the life of Robert Clive, who laid the first solid foundations of British rule in India.

Clive, the son of a small Shropshire squire, was born in Market Drayton. He was an unruly boy, but stories told of him suggest that he was brave as well as mischievous—as, for instance, his climbing the church steeple at Market Drayton and sitting astride the gargoyle near the top. When he was 18 he became a writer, or clerk, in the service of the East India Company, and was sent to Madras.

The Company had been established simply for trading, but was also responsible for administration in the territories leased to it by Indian rulers for its factories, or settlements, which it employed its own soldiers to defend. The French had similar settlements. India, by then no longer united under the Mogul emperors, was in a state of strife, and French and British were seeking to foster their own trade and influence by forming alliances with rival rulers. In the first rounds the French, under Dupleix, governor of their settlement at Pondicherry, had the advantage, and in 1746 they captured Madras. Clive escaped and joined the Company's forces as an ensign, till the treaty of Aix-la-Chapelle in 1748 restored Madras to the British and sent him back to his desk.

CLIVE OF INDIA

This portrait, reproduced from a painting by Nathaniel Dance, shows Lord Clive after his return from India. The original is in the National Portrait Gallery, London.

Though nominally at peace outside India, French and British now supported rival rulers claiming to control territories in South India. In 1751 the British-supported claimant to the Carnatic was besieged in Trichinopoly. Attempts to raise the siege had failed, and Clive, now a captain, suggested creating a diversion by sending an expedition against Arcot, capital of the Carnatic. He was given command of a small force of European and Indian soldiers, and occupied the fort, which he found deserted. Besieging forces were diverted from Trichinopoly, and laid siege to Clive. His heroic bearing inspired his troops to repel the besiegers, who withdrew. Trichinopoly was then relieved.

Clive now married, and returned to England, where he was enthusiastically received. He failed to keep a seat in Parliament, however, and returned

to India in 1756, just before the outbreak of the Seven Years' War, as lieutenant-governor of Fort St. David, at Madras. He reached Madras the day before the capture of Calcutta by Surajah Dowleh, ruler of Bengal, and the accompanying outrage of the Black Hole. He was at once dispatched to recapture the city, and succeeded also in capturing the near-by French settlement of Chandernagore.

Deciding there would be no peace in Bengal under Surajah Dowleh, Clive decided to replace him with the commander of his troops, Mir Jafar, and entered into secret negotiations with a Bengali agent. Fearing betrayal, he deceived this agent with a forged copy of a treaty—an action out of keeping with his character. On June 12, 1757, his small, trained force won an easy victory over the twenty times larger but undisciplined forces of Surajah Dowleh at Plassey. Mir Jafar was enthroned, and gave Clive a large reward. French power was overthrown, and for the next four years Clive virtually ruled Bengal, keeping an eye, too, on British interests in the south. "The heaven-born general," as Pitt called him, proved equally able at administration, though he made some errors which were to prove costly. On his return to England in 1760 honours were showered upon him. He was made an Irish baron and a Knight of the Bath, and elected to Parliament for the Shrewsbury division.

Meanwhile accounts reached England of growing corruption and disorder in Bengal. Clive was reappointed governor, and remained from 1765-1767, putting down abuses with great firmness, reorganizing the armed forces, and improving the administration. His services far outweighed his earlier errors, but made him enemies, and when ill-health brought him back to England he found himself the victim of attacks in pamphlets and elsewhere. An inquiry instituted by the House of Commons lasted for two years. Charged particularly with having accepted large rewards from Indians, he made the historic retort: "By God, Mr. Chairman, at this moment I stand astonished at my own moderation." Finally he was completely vindicated, but his health was already broken, and the criticisms preyed on his mind, bringing on the depression that led to his suicide. His work lived on, however, and generations of his countrymen have freely recognized his greatness. (*See* British Commonwealth; Hastings, Warren; India; Seven Years' War.)

MACHINES *for* TELLING *the* TIME

Clocks and Watches. If you fix a straight pole upright in a sunny place, you can make a time-teller—the writer has done this when mining in Canada and there were no other means of knowing the time. Actually, this was probably the first method of marking the passing of time used by man, and is believed to have been invented by the Babylonians about 3,000 years ago. They noticed that the position of a shadow changed during the hours of daylight, and, having fixed a pole in position, they saw that its shadow (later called the gnomon) moved round. They also discovered that it was long at sunrise and gradually grew shorter and shorter until it reached a certain point when it began to lengthen again, until at sunset it was as long as at sunrise. The shortest shadow marks noon, or 12 o'clock midday (1 o'clock summer time).

This simple pole-shadow device was the father of the various shadow clocks or sundials, such as the T-shaped object used by the ancient Egyptians and the half-basin shape called a hemicycle, hollowed from a piece of stone and the inside marked to show twelve parts of the day. In the course of time the interesting sundials with the hour figures engraved on a metal plate, similar to the everyday clock dial, were developed. There are many of these in gardens, and they are well worth studying.

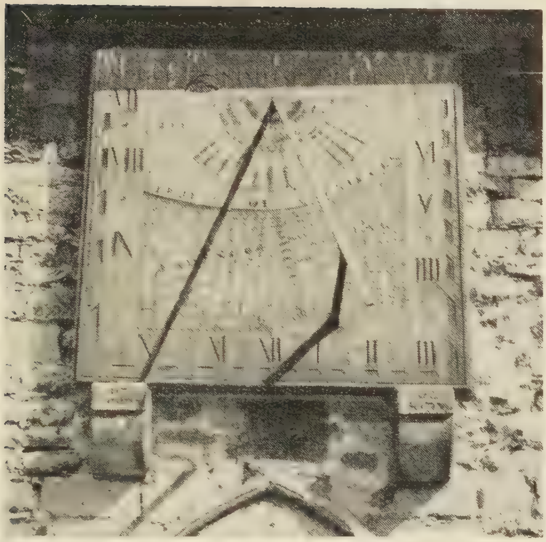
Sundials were also placed in a vertical position on the side of a building and some of these are still to be seen. And on the south wall of some old country churches can be found curious scratches, sometimes a circle with marks suggesting a clock dial and sometimes merely a series of lines. Known as scratch dials, these are quite small, and were to a great extent the church "clock" for the parson of the Middle Ages.

The sundial was the ancestor of the clock dial, but the mechanical clock which consists of a series of wheels and pinions (tiny cogwheels with a small number of teeth, or leaves, as they are called) is descended from the water clock or clepsydra (stealer of water). Water clocks of different kinds were used in ancient Egypt, and examples of them have been preserved to the present time. The more simple ones included a tapering vessel, looking rather like a modern flower-pot, with the hours

Science Museum

WATER-CLOCK FROM EGYPT

On view at the Science Museum, London, is this cast of the original clock (now in the Cairo Museum, Egypt) which was found at Karnak, Upper Egypt, in 1904, and dates from the reign of King Amenhotep III (1415–1380 B.C.). The vessel was filled with water, which leaked through a small hole near the bottom, the time being indicated by the level of the water within. The bowl was probably used to mark the passage of time at night.



Reece Winstone

SUNDIAL OR SHADOW CLOCK

The sundial, ancestor of the clock dial, was a development of the simple pole-shadow device used by the Babylonians some 3,000 years ago. In due course the hour figures were engraved on metal. There was often a Latin motto.

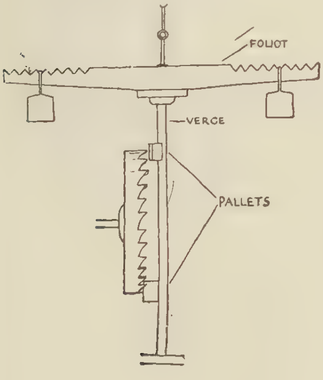
marked on the inside; it was filled with water which trickled from a small hole in the side near the bottom, and as the water dripped and lowered the level, it showed the different hours marked on the inside. Another device was a bowl fitted with a tiny spout from which the water fell into another vessel marked with the hours.

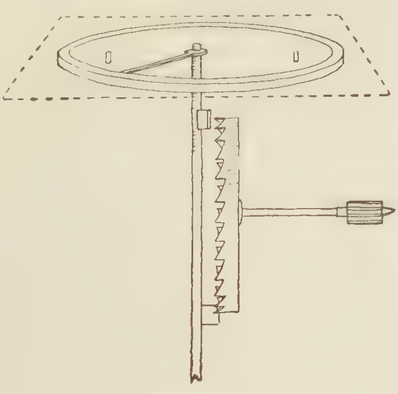
Everyone knows the little glass "egg-boilers" in which sand runs from the top bulb to the lower one to mark the time in which an egg should be boiled. Long ago, larger sand-glasses of exactly the same shape were used to mark the passing of the hours. In some old churches you can see a bracket at the side of the pulpit, occasionally, though not often, with a sand-glass. These measures were to remind a clergyman of the proper length for his sermon. Old church records speak of a sermon of "one whole houre-glasse" or "one halfe houre-glasse."

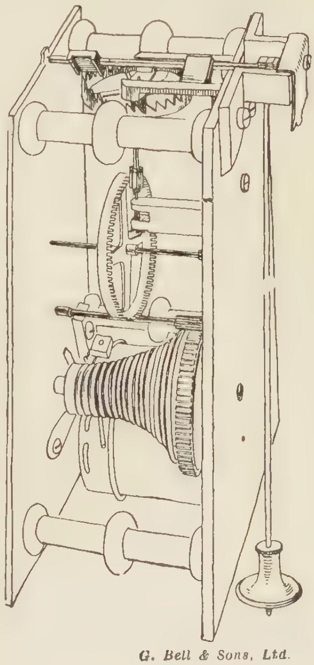
The exact date of the invention of mechanical clocks driven by weights is unknown. The earliest examples still existing date from about 1250. These were used in the towers of cathedrals and other buildings and, like all the first clocks, were made by blacksmiths of wrought iron. There are several in the Science Museum, London.

The verge escapement is a vertical spindle (the verge) to which are fixed two small projecting "tongues" called pallets, at almost a right angle with the spindle; the foliot being a cross-bar with an adjustable weight at each end, fitted to the top of the spindle or verge. This cross-bar swings to and fro, and so causes the small projecting pieces (pallets) to come alternately against a tooth of a wheel called the crown wheel, which pushes it aside and escapes when the other projecting pallet comes against a tooth on the opposite side of the wheel. The purpose of this is to check the pull of the heavy weight that drives the clock. Without this check or escapement all the wheels of the clock would spin round as fast as they could and the clock would "run down" in a few moments.

No clock small enough for the house was produced in England until the late 16th century, though they had been made earlier on the Continent. These early house clocks are referred to as "bedpost," "birdcage," and "Cromwellian," but they are generally known as lantern clocks. Like the great turret clocks, the first lantern timepiece had stout iron wheels fitted in an iron frame driven by weights with the verge escapement and foliot or cross-bar explained above. Most of those made by English clockmakers, however, were fitted with the balance wheel in place of the foliot. This balance wheel swings to and fro, at each swing coming against a small stud which causes it to rebound and swing in the opposite direction, thus turning the verge and causing the pallets to fall against a tooth of the escape wheel, first on one side and then on the other. This device works on the same principle as the foliot or cross-bar.







THE VERGE ESCAPEMENT

On the left are shown the foliot balance, the adjustable weights, and vertical crown wheel. In the centre is the balance-wheel, which was introduced later. On the right is the movement with the spring, fusee drive, horizontal crown wheel, and the short pendulum. (See full description in text.)

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SUPERB BRACKET CLOCK

Bracket clocks were intended to be carried from room to room, for which reason a handle was fitted. This example, made by John Shaw (*c.* 1685), has a metal double-basket top, and chased mounts on doors and sides.

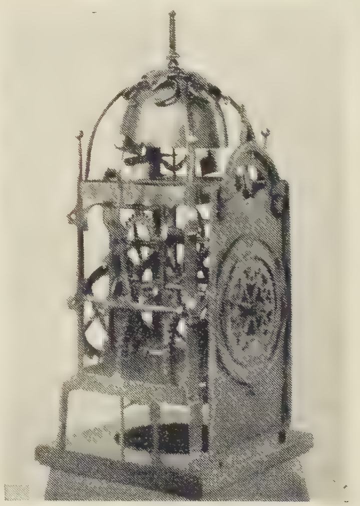
Round about 1660 the pendulum came into use and the swinging balance wheel was replaced by a short pendulum with a small bob. This change was achieved by placing the escape wheel in a horizontal position with the verge and pallets above it and fixing the pendulum rod to the end of the verge. By this, as the pendulum swung from one side to the other, the pallets fell alternately against a tooth of the escape wheel which, pushing it aside, escaped in the same way as when the verge or spindle and wheel were vertical.

All lantern clocks go for 30 hours between windings, and are wound by pulling the end of each cord and so raising the weights. Because of the hanging weights and cords, an early lantern clock could not be placed on a mantelpiece, so it was usually supported on a wall bracket, the cords by which the weights were suspended being passed through holes cut in the bracket.

Round about the same time that the pendulum was adopted, the weights were replaced by the spring drive, and a lantern clock could then be placed on a mantelpiece where, to most people, a clock is more "at home" than hanging on a wall with the weights dangling down below. And present-day clockmakers are producing some really excellent copies of the lantern clocks of long ago in sizes from quite tiny ones, 3 inches high. While perhaps these modern lanterns are not as romantic as the old ones, they have several advantages. First, being fitted with eight-day lever movements, they are far more accurate time-keepers. Also, as we are nowadays more familiar with a clock which has two hands, they are fitted with the additional "long" or minute hand; and with some, too, the inner circle of the hour ring is engraved with the 60 minute divisions, though as a general rule the original 48 or quarter-hours are repeated.

Because in earlier times it was most often supported on a bracket, the lantern clock is, strictly speaking, a bracket clock; but that term has come to be applied to the portable clocks in various styles of wooden case. The later ones are, however, descended from the lantern clock. After the weights were replaced by the spring drive, the lantern clock was enclosed in a wooden case, and during the later 17th century the time-keeping qualities were improved by the adoption of the anchor escapement and long pendulum with heavier disc. The first clocks in wooden cases had the square dial, but this was later changed to the circular dial.

Like its ancestor the lantern, a bracket clock adds much to the charm of a room. All the cases are decorative without being in any way showy, and there are a number of styles to choose from, for, from the time they became fashionable until the early years of the 19th century, at least ten types of case for bracket clocks were fashionable at different times. At first the case was quite simple, then during the reign of William and Mary elaborately pierced and chased metal tops were added, some of these being of silver, and the sides



Left, Science Museum

TWO LANTERN TIMEPIECES

On the left is a striking clock of iron, of the type called "lantern," with the original foliot balance, adjustable weights, and verge and crown-wheel escapement. It dates from the 16th century. On the right is a lantern clock made in the 17th or 18th century.

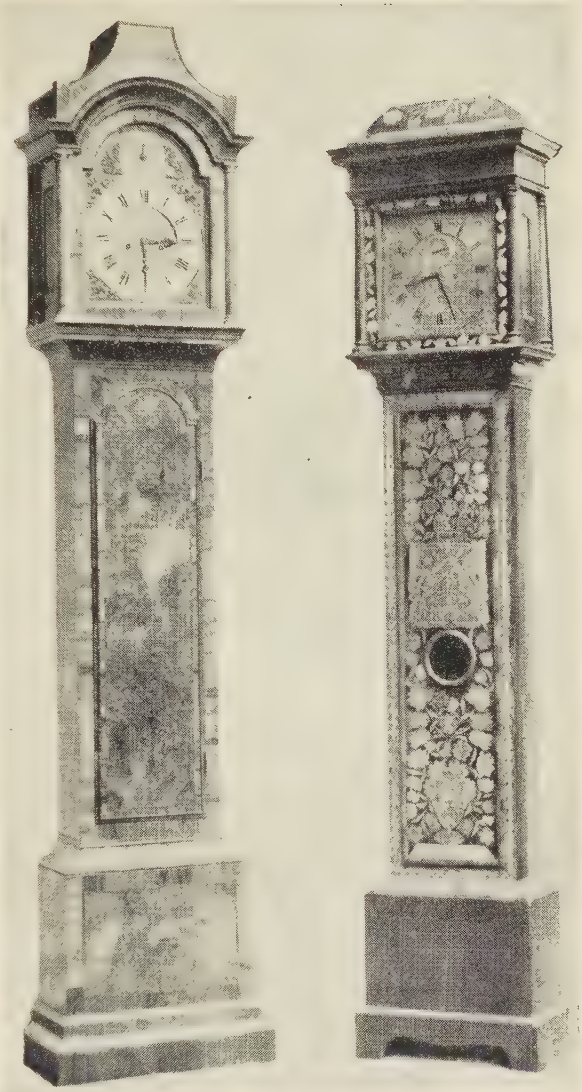
and door-front were decorated with applied metal. During the reign of Queen Anne and later, the cases were generally less elaborate, the decorative qualities depending rather upon the selection of beautiful wood than upon the use of ornamental metal mounts, though the latter were used occasionally. Sometimes the cases were decorated with marquetry or veneered with tortoise-shell (that is, thin pieces of the shell glued to the wood frame).

There are three styles of bracket clock case with the pierced and chased metal tops, and these are called basket top, bell basket top, and double basket top, the last having three tiers and being the most elaborate. Those that followed during the 18th century, in the order in which they appeared, were called inverted bell, bell top, broken arch, arch top, lancet, and balloon.

Although a mantelpiece is usually thought the suitable place for the average-sized bracket clock, it can be unusually effective on a table, or raised on a simple wall bracket at eye level. In former days a clock of this type was often placed on a table, which explains why the door at the back has a glass panel and the back plate of the clock is beautifully decorated with intricate engraved work.

It is now possible to obtain copies of early bracket clocks, and these delightful little time-pieces (some only four inches high) are fitted with eight-day lever movements (or " works," as they are commonly called).

When the spring-driven lantern clock was enclosed in a wooden case to become what is known as a bracket clock, the weight-driven lantern was covered with a wooden hood with the weights exposed below, and became the cottage wall clock. Then someone thought of enclosing the weights and cords in a cupboard-like case, and the grandfather clock was born. Perhaps the idea was to prevent the family cat from playing with the weights and stopping the clock or to protect them from being swung to and fro by draught, or, what is more probable, it was a desire for an attractive piece of furniture instead of the rather naked-looking wall clock.

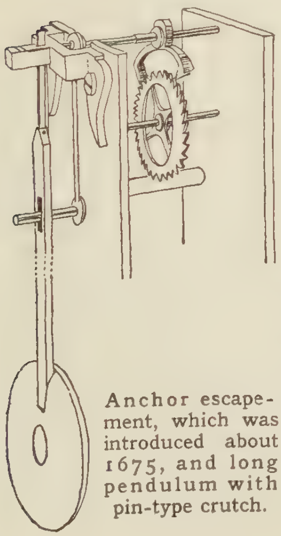


Gill and Reigate

TWO HANDSOME GRANDFATHER CLOCKS

The grandfather clock, which has a very long case, is operated by heavy weights suspended on catgut lines, each coiled round a drum when wound up. These two examples, both in walnut cases, date from the reign of Queen Anne (1702–14)

All the first grandfather clocks had a lantern clock movement and needed winding every day; and, like the lantern, they were wound by pulling the cords and raising the weights; but after the going and striking trains (the series of wheels and pinions) were placed side by side instead of one behind the other as with the lantern, the thirty-hour grandfather was wound with a key by winding holes in the dial.



Anchor escapement, which was introduced about 1675, and long pendulum with pin-type crutch.

Thirty-hour grandfather clocks are still in use and keeping good time. Many of the cases are of fine wood and very ornamental.

Any grandfather clock in going order is a reliable time-keeper and, by raising or lowering the pendulum bob by a small nut under the bob, may be made to " strike with the pips " that come over the radio. Again, the movement of an ordinary eight-day grandfather is a remarkably simple arrangement of wheels and pinions—and as the hood may be lifted off and the working parts seen clearly (but not touched), it will be interesting to follow how these various parts work together to make the clock tell the time and strike the hour.

Like the great turret clocks which were made by blacksmiths centuries ago, the grandfather clock is driven by the pull of heavy weights sus-

Victoria and Albert Museum

ENGLISH TABLE CLOCK

Few of the original ornamented English table clocks have survived. This specimen was made by David Ramsay (*c.* 1625), but the workmanship of the case suggests that the case itself may be the work of a foreign craftsman.

pended on catgut lines, each coiled round a drum when wound up. One end of the axle (known as the arbor) of the drum extends to the dial and, there, has a square end for the winding key. On the other end there is a large toothed wheel with a small wheel attached. This small wheel, called the ratchet wheel, merely prevents the drum from turning in the opposite direction when winding up the weight. The larger toothed wheel is the one that does the driving.

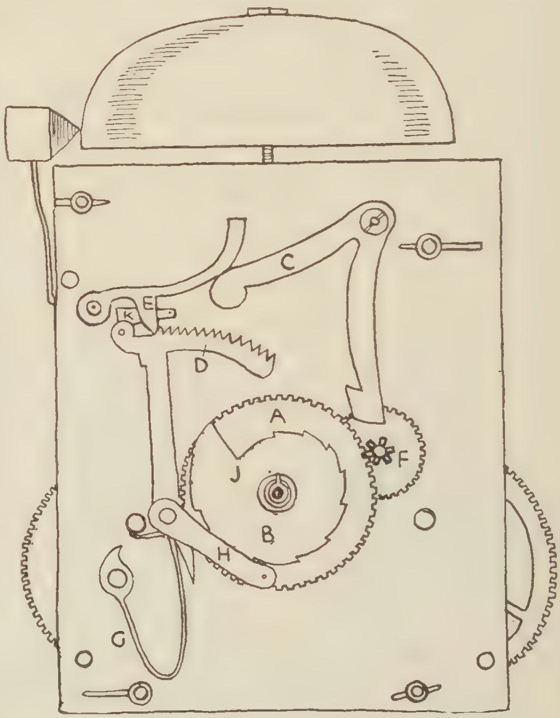
When the weight is wound up, it pulls on and turns the drum, and thus the driving wheel turns. This engages a tiny cogwheel (called a pinion) on the axle of a wheel called the centre wheel—one end of the axle of this wheel passes through the dial, and the long or minute hand is fastened to the square end. The centre wheel engages another tiny cogwheel which, in turn, drives the second wheel, which also engages a tiny cogwheel above it and turns what is known as the escape wheel. This is the one at the top which is stopped momentarily by a small triangular tooth (called a pallet) on one side of an anchor-like gadget that rocks from side to side; and as the pallet lifts, the tooth of the wheel escapes and the pallet on the other arm of the anchor comes against another tooth and again momentarily stops the escape wheel, as seen in the diagram on the previous page. The axle of this wheel extends to the dial, and on it a small pointer is fixed to register the passing of the seconds on a small dial usually placed just below the figure XII.

On the other side, between the two brass plates (that is, the left side as you look at the clock), there is another drum on which the catgut line of a second weight is wound to drive the striking. This, too, has a driving wheel similar to the one already described, and there is also a series of wheels and pinions and what is called a fan-fly. With this part of the clock the driving wheel operates in the same way as that of the going part and engages a tiny cogwheel which turns a wheel having eight pins on the rim; this pin-wheel "trips" the tail off and so lifts the hammer which strikes the gong.

As the wheel with the eight pins turns, it engages a pinion of a wheel above it and the latter engages a pinion and drives the fan-fly. The wheel that drives the last pinion has 48 teeth; and so, as the pinion has only seven, the fan-fly whizzes round at high speed, and by its resistance to the air regulates the speed of the wheels forming the striking train.

Other wheels and curiously shaped pieces connected with the striking are outside the front plate and behind the dial. One wheel, known as the minute wheel, rides on the extended axle of the centre wheel, referred to above, and turns the long or minute hand, thus going round the circle once each hour. The minute wheel engages with another called the reversed hour or motion wheel to which is attached a tiny cogwheel of six cogs, and the little cogwheel drives a large wheel of 72 teeth; thus the large wheel (the hour wheel) makes a complete circle once in 12 hours—72 divided by 6—and turns what is known as a "pipe" on which the hour hand is carried.

In front of the hour wheel and fixed to the "pipe" there is a curious notched plate shaped rather like a snail, which is the name it is known by, and this controls the striking. As the long or



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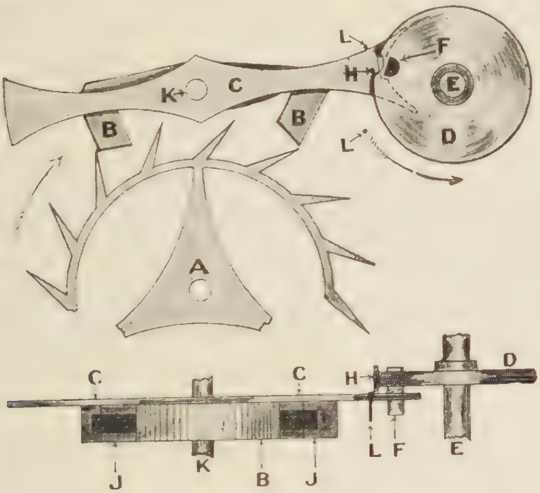
MOTION WORK OF AN 8-DAY CLOCK

The large wheel (A) with 72 teeth revolves once in 12 hours, and turns the "pipe" to which the hour hand is secured. Fixed to the same "pipe" is a notched plate (B), to control the striking. Other pieces in the striking mechanism are a lifting piece (C), a rack (D), a rack hook (E), and a gathering pallet (K). The motion, or reversed wheel (F), is turned by the minute hand. The rack (D) is pushed by the spring (G). The rack has a tail (H), controlled by (B). At 12 o'clock the tail reaches the right angle (J).

minute hand turns, the reversed hour or motion wheel turns, and as the hand comes round to approach XII, a small pin on the side of the motion wheel is brought up against the tail of an inverted L-shaped piece, called the lifting piece. As the minute hand moves closer to XII, the pin on the motion wheel continues to push against the lifting piece until the "arm" of the L-shaped piece raises a small tooth from the "rack"—a series of teeth on the slightly curved arm forming part of another inverted L-shape with a tail.

When the small tooth is lifted, the rack is released and pushed by a spring at the end of its tail, falls to the left and it is then you hear the "warning" that the clock will soon strike. The distance or number of teeth the rack can fall to the left is controlled by the position of the snail against which the tail at the bottom falls; thus, at 1 o'clock it falls against a shallow notch which releases only one tooth, but at 12 o'clock it falls into the deepest hollow, when twelve teeth are released and the rack falls its full distance.

Immediately the minute hand reaches XII, the pin on the motion wheel passes the L-shaped



ESCAPEMENT FOR WATCHES

The detached lever escapement is illustrated here. The parts are (A) escape wheel; (B) pallets; (C) lever between wheel and balance; (D) roller on balance staff (E); (F) impulse pin; (H) guard pin; (J) jewelled pallet faces; (K) axis on which pallet and lever swing; (L) banking pins to restrain lever.

lifting piece, which drops and allows the rack hook to fall into a tooth of the rack, and the striking wheels are free. A small rotating tooth (called a gathering pallet) picks up a tooth of the rack each time the striking wheel lifts the hammer, and so pulls the rack back to the right until the rotating tooth is stopped by a pin at the left end of the rack.

One of the mysteries of a clock is what makes the pendulum continue to swing. Actually it is a quite simple arrangement. If you look at the top of the pendulum rod of a grandfather or other clock, you will see it is suspended from a small bracket by a piece of spring steel; also that it swings in a fork (rather like a tuning fork) or perhaps a loop or a pin passing through a slot in the rod. This fork, loop, or pin, called a crutch, is at

John H. Stone

KNOWN ROUND THE WORLD

Behind the statue of Boadicea is the giant clock of the British houses of parliament, which is called Big Ben. Its mechanism was made in 1858, and its bell (the true Big Ben) is heard every day on the radio all over the world.

right angles to the lower end of a short steel rod, the other end of which is fixed to the axle of the anchor-like piece. As the power from the driving wheel is transmitted through the various wheels and pinions to the escape wheel, it causes the escape wheel to push aside first one and then the other pallet of the anchor as explained above. And as the anchor rocks to and fro, its axle "rolls" and makes the crutch swing and push gently against the pendulum rod and so keep it swinging.

When people recognized the value of a clock which showed the time of day on a dial, they began to demand timepieces small enough to be carried about. It was Peter Hele, of Nuremberg, who made this possible. In 1490 he invented the coiled spring, the whole foundation of all future spring-driven clocks and watches.

Hele fixed one end of a steel ribbon to a spindle, turned the spindle, and tightly wound the steel ribbon round it, using the force of the coiled spring to drive the movement of a timepiece, thus doing away with weights. One record of his day says he made "small horologes (timepieces) of iron fitted with a number of wheels, which, wherever they may be borne and without a weight show and strike forty hours" and adds that these "small horologes" could be carried in the pocket.

But the power of a spring confined in a drum becomes less as it uncoils, so that Hele's timepieces, while novel, were relatively useless as time-keepers. A few years later this disadvantage was remedied to some extent by the introduction of the fusee-and-spring invented by Jacob Zech, which allowed more reliable small clocks to be made.

Zech's invention, which is used even now in some timepieces, consists of a cone with spiral grooves (the fusee) to which a driving wheel is fixed. A catgut line is fastened at one end to the fusee and at the other to the drum containing the spring. In later years a small chain or a cabled wire replaced the catgut line. It is wound by turning the fusee with a key, thus drawing the catgut line or chain from the drum to the spiral grooves, which tightly coils the spring in the drum.

The spring, straining to uncoil itself, pulls the line from the fusee and winds it round the drum. It begins to pull the line from the small end of the cone for this reason: when the spring is tightly wound, its power is stronger than it becomes as it uncoils, and this is compensated for by the gradually increasing size of the fusee.

It was not until technicians evolved the modern electric clock that periodic winding was dispensed with. Clocks powered by electricity have neither weights nor springs; the kind more generally used with alternating current consists of a simple motor geared to a pair of clock hands. An electric clock of this type may be connected to the power by being plugged into a wall socket, and, once set, will continue to record the exact time, as long as the supply of current is not cut or varied.

The movement of a watch, like that of a clock, consists of a series of wheels and pinions (the train), and the first pocket timepieces had the verge escapement which continued to be used until fairly recently. In the meantime many other escapements were invented and adopted, and of these the best and most generally used is the lever escapement invented by Thomas Mudge in 1760.

Watches of long ago were by no means good timekeepers and were valued more as personal jewelry. Because of this the cases were usually much more beautiful than those of modern watches. The early cases were not always circular. Many were made in the form of a flower, insect, small animal, or other fancy shape; also both the cases and the dials were decorated with flowers and other pictures in coloured enamels and sometimes with jewels. When Oliver Cromwell became Protector and the Puritans came to power, the beautiful watch cases disappeared and were replaced by quite plain designs. Oliver Cromwell's own watch, which is in the British Museum, has a small circular dial with one hand, in a plain oval silver case.

The beautiful workmanship of old watch-cases can be studied at such places as the British Museum, the Guildhall Museum, and the Science Museum; and at the Science Museum you can learn much about the various parts of clocks and watches and how they work, because there are large scale models of escapements, clock movements showing the details of the fusee drive, and other mechanisms. The article on CHRONOMETER also contains useful information on clock-making.

Cloth. Fibrous materials such as wool, cotton, linen, silk—or the newer man-made fibres—are made into cloth by weaving, felting, or knitting. Felting and weaving are ancient arts, but the process of knitting appears to be only about five centuries old. Felting is simply the matting together of the fibres by moisture and pressure, so that they are held by their own roughness or curl. Wool has a rough, scaly fibre and thus mats very readily, but it is often mixed with hair or cotton for cheaper qualities of felt (see article).

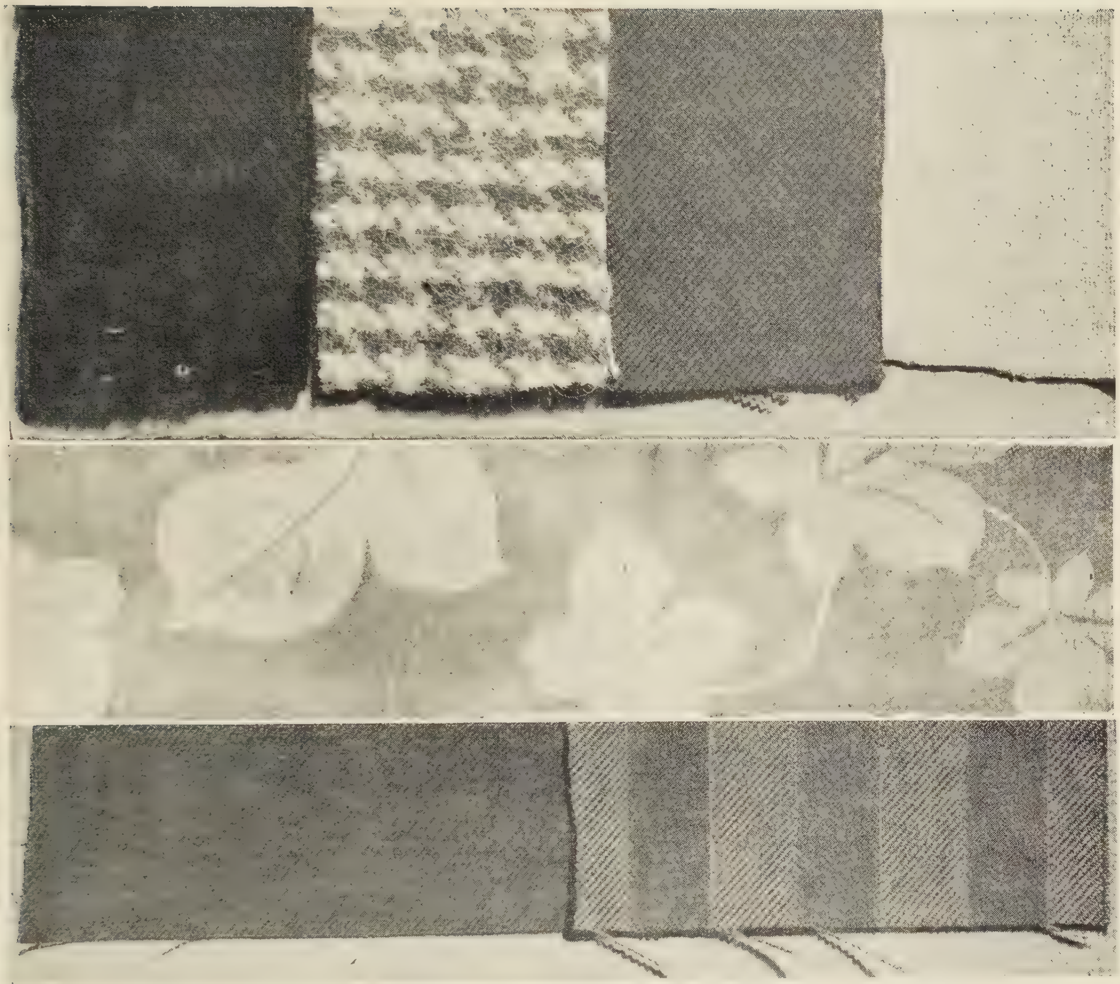
Weaving had its beginning among primitive peoples in the twisting, braiding, and interlacing of grasses and coarse plant fibres in order to make simple garments, floor-mats, and other articles; and the peoples of many different countries have contributed their skill and ingenuity to developing the industry. All woven fabrics have at least two sets of threads crossing at right angles: lengthwise threads, called the warp, act as a foundation; and over and under the warp pass the crosswise threads of the weft or woof. (*See* LOOM; WEAVING.)

CASES AND DIALS OF SOME EARLY WATCHES

The watches in the photograph are examples of 16th- and 18th-century workmanship. The watches of long ago were not usually good timekeepers, and were valued more as personal jewelry, which accounts for the ornamented cases. In some early watches the dials, too, were decorated with enamels, engraving, and even jewels.

Wool yarn is woven into woollen goods, such as tweeds, velours, elysians (heavy cloths suitable for overcoats), and fearnoughts (rough, hairy cloths); and into worsted goods for fine flannels and suitings. Worsteds take their name from the village of Worstead in Norfolk, where weaving was carried on in the 14th century, and they differ from woollens in that only the longer fibres are used and laid parallel during spinning. Trade names for different goods cannot be depended upon to indicate the quality of the wool or material used in their manufacture. Some terms simply apply to the different weaves and finishing processes used.

In velvets, besides the ordinary warp and weft



CLOTH OF MANY KINDS FOR EVERYDAY USE

A very large number of materials come under the designation of "cloth," including most of our clothing and many household furnishings, while, as fashions change, new varieties of cloth are constantly being produced. Here are seven examples of the cloths most in use. 1. Rich silk velvet. 2. Harris tweed. 3. Blue serge. 4. Cotton rep. 5. Linen damask with a pattern woven into it. 6. Alpaca lining with a cotton warp. 7. Light-weight worsted.

threads, there is an additional weft which is left standing up in little loops, so close together as to hide the regular web. When a piece comes from the loom, the loops are cut evenly so that the ends stand up from the cloth and have the appearance of short fur. When this nap, or pile, is long, the fabric is called plush. A coarser example of this looping of the extra thread is in Turkish towels.

Damask is a fabric originally manufactured in the city of Damascus, in Syria, from which it took its name. It was then made of silk and was distinguished by its ornamental woven figures of fruits, flowers, animals, and landscapes. The term is now applied to stuffs made for table-covers, draperies, and furniture coverings, which have patterns woven in the loom. Brocade is a similar cloth, woven with raised figures.

Linen fabrics are made of the soft silky fibre obtained from the stems of the flax plant. There are cambric and lawn linens, expensive tablecloths of linen, and also the coarser weaves such as the huckaback towelling.

Calico takes its name from Calicut, a seaport of Kerala state on the west coast of India. The name was first given to white cotton cloth, but it now includes coloured cotton cloths that are not sufficiently fine to be classed as muslins (named from Mosul, Iraq). Calico printing, by which the cloth is given any desired pattern, was at first done by means of wooden blocks pressed upon the cloth by hand, but now it is performed by great printing presses. This printing process can also be applied to woollen, worsted, silk, and linen fabrics.

Knitted goods somewhat resemble the woven fabrics, but are much more elastic. They ravel more easily, since they are made by looping a single thread (as in hand knitting) instead of interweaving warp and weft. Knitting was first used for stockings and underwear.

True alpaca cloth is woven from the wool of the South American animal of the same name, but certain light cotton and wool imitations with shiny surfaces are called alpaca in the textile trade. Similarly, the name mohair, which belongs pro-

perly to cloth made from the hair of Angora goats, is often given to imitations.

The 20th century has seen the successful manufacture of many man-made fibres for weaving and knitting—some with a silky texture and made from cellulose (see article) ; others made from materials themselves synthesised by the chemist (nylon is an example). (See articles on the principal woven materials, *e.g.* Cotton ; Linen ; Nylon ; Rayon ; Silk ; Wool.)

Clothes. The earliest civilizations developed for the most part in comparatively warm climates, and so it does not appear that protection against the cold was the primary purpose of clothes. Vanity seems to have been a more usual motive, and even to-day it is found that savages are more likely to adorn themselves with beads or stick a feather in their hair than to devise some kind of garment for their bodies. It is probable also that some kind of pouch to carry things in was an early invention and in fact preceded the loin-cloth.

A good deal is known about Ancient Egyptian costume, for the Egyptians left many pictorial records from which it is plain that clothes were at first worn only by people of rank. The lower classes went about entirely naked. A simple loin-cloth or short skirt was the next stage. Later, women wore simple sheath-like garments reaching to just above the waist. The materials used were cotton and flax.

Assyrian clothes were in general long, and seem to have been made of several fringed shawls, mostly of wool. The Medes and Persians wore trousers, garments long regarded by the Greeks and Romans as typically " barbarian." The clothes of the Mycenaean culture, which preceded that of the Greeks, had several surprising features, notably a very tight waist and a flounced skirt having a curiously modern look. Greek costume was draped and very simple, consisting of a loose tunic and a cloak, both in early times unsewn and kept in place with brooches and a girdle. The Etruscans seem to have invented the toga, a loose flowing garment taken over by the Roman aristocrats. It was a very large half circle of woollen cloth draped over the body, leaving one shoulder bare. Roman clothes, stylised and enriched with jewelry and embroidery, persisted into the Byzantine world. (See picture on page 155 of this volume.)

The barbarians who brought the Roman Empire to an end wore trousers, generally cross-gartered, together with one or two tunics and a cloak. This costume lasted throughout the Dark Ages, and it was not until the Crusades brought knowledge of Oriental luxury that the garments of western Europe became more refined. Men's dress in the Middle Ages consisted of tight-fitting hose together with a long, full gown with tight sleeves. A decorated belt hung round the hips, and from this was suspended the sword, dagger, and pouch. Women wore long, loose garments, with veils on their heads, so that everything but the face was concealed. It was not until the end of the 13th century that clothes began to be shaped to the figure. Soon followed the cutting away of the bodice (*décolletage*) and the growing popularity of striking and fanciful headdresses.

MINOAN FLOUNCES, PERSIAN TROUSERS
The dress worn by the Minoan snake goddess (left) has a tight waist, and a flounced skirt, which has quite a modern look. The Medes and Persians wore trousers, which appear to have needed bracing up !

At the end of the 14th century the elaboration of women's headgear became most marked ; and men, abandoning the cowl which had served them so long, began to wear hats. Shoes became excessively pointed. Something which can be recognized as fashion now introduced an element of perpetual change, and the luxurious courts of France and Burgundy vied with one another in extravagant display. The Renaissance in Italy introduced new modes, and this influence was speedily followed by that of the Holy Roman Empire, especially in the time of the Emperor Maximilian. English Tudor costumes had a strong German stamp, particularly in the habit of slashing —cutting holes in an outer garment to show a garment of contrasting colour underneath. Women of the early 16th century wore a stiff headdress like a Tudor arch.

By the middle of the century Spanish influence on English costume had become most marked. For the next fifty years the characteristic of male costume was the puffed hose worn over long tights. Women began to wear the farthingale (a kind of primitive crinoline) to make the hips look larger. Both sexes wore the characteristic ruff, a kind of disc of pleated linen worn round the neck. Queen Elizabeth I in her later years divided the ruff to form two wings of lace and net standing up behind the shoulders. The same fashion continued with little modification until the end of the reign of James I.

By comparison the " Cavalier " costumes of the time of Charles I were elegant and simple. The ruff was abandoned for a falling collar of lace or linen. Trunk hose gave place to breeches, and women abandoned the farthingale. Hair was worn long by both sexes. The Puritans, however, wore their hair short ("Roundheads") and had very plain collars. In the second half of the 17th

NINE HUNDRED YEARS OF MALE COSTUME

1000

1440

1548

1616

1630

1630

1660

1690

1766

1831

1900

Specially drawn for this work by Robin Jacques

Men's clothes in Saxon times were primitive, and changed little until the Crusades brought in a new love of luxury. Jerkins, or tunics, worn with tight-fitting hose, remained the essentials of male wear until in the mid-16th century the puffed hose became more important. During the 18th century male costume remained virtually unaltered, but at the beginning of the 19th century came plain coats. Trousers were introduced soon afterwards.

NINE HUNDRED YEARS OF WOMEN'S DRESS

Specially drawn for this work by Robin Jacques

There was comparatively little change in women's dress from the fall of the Roman Empire until the 14th century. Then, in a generation, Fashion—the attempt to make clothes attractive—was invented, with shaped waists and bodices, and coloured materials ; but for a long time only the rich could afford to dress fashionably. In the 17th century fashion changes began to take place more rapidly, and the process has been continually speeded up ever since.

century there was a mania for ribbons. Natural long hair gave place to the elaborately curled periwig.

A new garment, the long coat worn over an equally long waistcoat, appeared in the 1670s, and this, slightly modified, lasted for more than a hundred years. Women, early in the 18th century, revived the farthingale in the form of "hoops." The three-cornered hat became the characteristic male headgear. Gradually, as the century progressed, it became smaller, as did also the wig, and the waistcoat.

Nineteenth and Twentieth Centuries

The French Revolution brought in a much simpler costume for both men and women. Men wore country clothes: a plain cloth coat cut away in a square panel, with riding boots and a tall hat. Women wore garments rather like nightdresses with very high waists. Hair was dressed close to the head and hats were small. The waist went back to its normal position in 1820, and skirts gradually extended until by the 1850s they needed to be supported by the wire frame known as a crinoline. Men's clothes, apart from the universal adoption of trousers, changed only slowly.

In the late 1860s the crinoline was abandoned in favour of the bustle, the material of the dress being bunched up behind. Skirts were smooth over the hips in 1880 but a new bustle appeared a few years later. The middle 1890s were marked by the reappearance of the balloon sleeves which had characterised the 1830s. Women's clothes were very elaborate in the early years of the 20th century, and did not really become simple until after the First World War. After that war came a change in women's clothes that had so lasting an effect that it can fairly be called revolutionary. For the first time in history, almost, the world was made publicly aware that women actually moved, like men, on two legs. Not only were skirts short, sometimes barely reaching the knees, but women also took joyously to wearing shorts for all kinds of sport and to trousers for many informal occasions. The day of trailing hems and gliding mystery appeared to have gone for ever. Elaboration in women's costume may now be said to be confined to "evening dress." But the greatest changes in later years have risen from the exploitation of new materials, garments of nylon and other plastics replacing the traditional wool, cotton, and silk, for almost every kind of garment.

Meanwhile, throughout the first half of the 20th century men's clothes became ever more informal and more comfortable, and here, too, the new synthetic fabrics have introduced a lightness of weight, combined with long-lasting quality, especially in under-garments, such as men have not experienced for many centuries.

Clouds. Both the countryman and the town-dweller in a rainy country like Great Britain are always conscious of the passing pageant of the clouds. Poets and painters alike have been inspired by their majesty or their delicate beauty; while those who can neither paint nor write must nevertheless have often felt their imaginations kindle as they lifted their eyes to the heavens and watched those remote and spacious patternings—marvelling especially, perhaps, that though both the shapes themselves and the pattern they make are for ever changing, they are never, never repeated. Nature offers everyone a free "continuous performance," but it is not her way to produce anything more than once. Cloud shapes are as individual as human beings. So if you should at any moment of the day look upwards and behold some particularly striking arrangement of the clouds, make the most of it, for it is quite certain that neither you nor anyone else will ever see precisely that same arrangement again.

Yet what are clouds after all? Nothing but water vapour.

As with all nature, there is a scientific, as well as a poetic, way of observing cloud formations. However insubstantial they are, there are certain scientific facts concerning them that give them additional interest to those in search of knowledge.

Water vapour is always present in the air, though it is sometimes invisible. As the air cools, part of the vapour is condensed into tiny floating globules of liquid water or crystals of ice or snow. This finely-divided but no longer vaporous water is called fog or mist if it trails on the ground, and cloud if it floats high above the surface of the earth. The average height of an upper layer of cloud in Great Britain is about 30,000 feet; the clouds there are nearly always ice crystals. The lowest clouds, usually composed of water droplets, are mostly between 500 and 5,000 feet.

Types of Cloud Formation

Although their shapes change constantly, clouds can be classified as belonging to one general kind or another. The method of classification now universally adopted is that contained in the International Cloud Atlas. It is based on the fact that clouds take up a comparatively limited number of forms according to the height at which they occur. The commonest of these forms is the heaped-up, woolly-looking mass which one sees on a spring day. Students of weather (meteorologists) call this type "cumulus," from the Latin for "heap."

Then there are those clouds which arrange themselves in huge horizontal sheets or layers; to those the name "stratus" (Latin, spread or stretched out) is given.

A third type consists of the clouds known as "cirrus" (Latin, curl) clouds, which have a light and airy appearance and are seen high up in the sky. The word "nimbus" (Latin, cloud) indicates a fourth type, and is given to the sort of cloud that produces rain.

Besides describing the form of a cloud (cirrus, cumulus, or stratus) the same international system of naming gives some indication of a cloud's height. Thus the prefix "cirro-" is used to denote clouds in the uppermost layers (30,000 feet), while the word "alto-" in front of the name of a cloud formation means that it occurs normally in the intermediate layers.

As given in the International Cloud Atlas, the modern classification consists of ten main types:

1. *Cirrus*, "detached clouds of delicate appearance, fibrous structure, without true shadows usually white in colour." Cirrus clouds consist of ice particles and take the most varied shapes, such as isolated tufts, thin filaments pencilled on a blue sky, branched filaments in feathery form, curved filaments ending in tufts, etc.

Harold Bastin

RED CLOVER IN BLOOM

The flower head of clover consists of many very small flowers, each shaped like a miniature lupin flower. They contain nectar from which bees make the best-quality honey. Red clover is the commonest British variety.

2. *Cirro-cumulus*, "small, rounded masses or white flakes without shadows, arranged in groups or lines, or sometimes in the form of ripples such as those formed on the seashore."

3. *Cirro-stratus*, "thin veil of whitish cloud, sometimes entirely diffuse and giving the sky a milky appearance, sometimes showing a fibrous structure."

4. *Alto-cumulus*, "rounded masses or discs, more or less large, arranged in groups, in lines or in rows, following one or two directions and sometimes so crowded together that their edges are joined."

5. *Alto-stratus*, "a veil of a colour more or less grey"; sometimes the sun or moon can be seen dimly through it, as through ground glass.

6. *Strato-cumulus*, "large, lumpy masses or rolls of dull, grey cloud, frequently covering the whole sky and sometimes giving it an undulating appearance."

7. *Stratus*, "a uniform layer of cloud, like fog in appearance but not lying on the ground."

8. *Nimbo-stratus*, "a low layer of structureless and rainy-looking cloud, sombre grey in colour."

9. *Cumulus*, defined as "thick cloud whose summit is dome-shaped and exhibits protuberances, while the base is nearly horizontal." True cumulus has well-defined upper and lower margins, but there are sometimes to be seen ragged clouds—like cumulus torn by strong wind—of which the detached portions are continually changing in shape; to this form the name *fracto-cumulus* is given.

10. *Cumulo-nimbus*, "great masses of cloud rising in the form of mountainous towers of which the upper parts, of fibrous texture, sometimes spread out in the form of an anvil." Such clouds usually produce electrical discharges, and when they are seen, a thunderstorm is quite likely to occur. (*See* CLIMATE; METEOROLOGY.)

Clover. In the sweet pea family called *Leguminosae*, the section or genus *Trifolium* with its "shamrock" leaves contains all the clovers and the little hop trefoil, over 20 kinds being found in Britain. Most of them grow in grassland, but a few are weeds and roadside plants. Each leaf has three leaflets which fold up and droop at night, and two little "wings" called stipules at the base of the stalk. The name clover was probably given because of the "cloven" (divided) leaves. The flower head consists of many tiny flowers, each shaped and constructed like a miniature lupin flower. They contain nectar from which bees make the best-quality honey. Red clover (which is really mauvish pink) is visited by bumble bees. As each little flower is pollinated it bends down and begins to turn brown, making one or two seeds in its very small pod.

Clover leaves are very nourishing food for cattle, sheep, and horses, which prefer them to grass; but an all-clover diet would be too rich for any animal, causing its stomach to expand like a balloon. Like other members of their family, clovers have long roots which develop lumps called nodules. In these live special bacteria, collecting nitrogen gas from the air in the soil and making substances called nitrates, which are a very important kind of plant food. The clover protects and partly feeds them, and any nitrate which it does not use will later enrich the soil. This is particularly useful if a wheat crop or other cereal is to be grown on that piece of land the following year.

When farmers plant clover they generally buy seed of specially cultivated varieties. The commonest British wild clovers are the "red," the wild white, which has creeping stems and is sometimes called Dutch clover, the alsike clover with large, pale-pink heads, and the crimson clover with tall, deep-red flower spikes. The shamrock (see article) is a kind of clover.

Cloves. Cooked with some stewed fruits such as apples or pears, which have little flavour of their own, you may find things like brown wooden nails, with a knob on their four-pointed tops and a slightly burning taste if chewed. These cloves, named from the French *clou*, meaning nail, are also used in chutneys. Their aromatic flavour comes from the oil they contain. They can also be ground to powder and used as flavouring, and the oil is used in boiled sweets (clove balls or clove "humbugs") and in liqueurs.

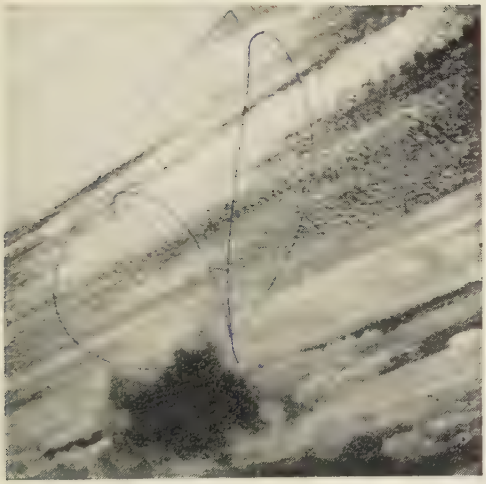
Cloves are the unopened flower buds of the clove tree *Eugenia caryophyllata*, an evergreen 20–40 ft. high, found originally in the Molucca Islands of the East Indies, but now growing in the Philippines, South India, tropical South America, and the islands of Pemba and Zanzibar off East Africa. The buds are gathered when they have turned from green to dull red, and are then dried brown in the sun. Japanese writings as old as 220 B.C. mention cloves, and the Arabs brought them to Europe in the 8th century.

Clove oil is extracted by distilling. It is a mixture of two oils called eugenol and sesquiturpine. Besides its use in sweets it is used in perfumes and

VARIETIES OF CLOUD FORMATION

Cirrus

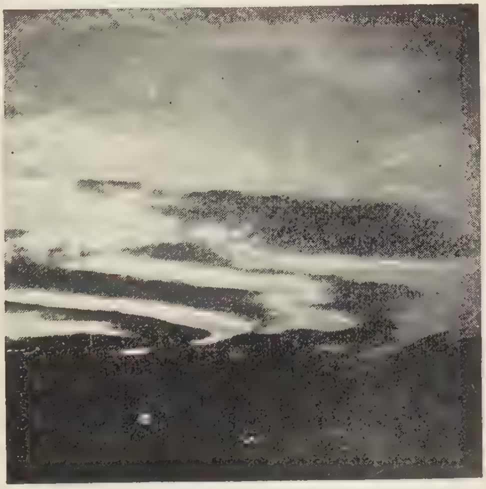
Cumulus



Cirro-cumulus

Alto-cumulus

Cumulo-nimbus



Strato-cumulus

BRANCH WITH LEAVES AND CLOVES

The flavouring called cloves comes from the dried buds of the clove tree ; the cloves yield oil. The tree grows in the East and West Indies, and on the island of Zanzibar.

cosmetics, and the same oil gives pinks and carnations their scent. Sections of animal and plant tissues are treated with clove oil before being examined under the microscope. A kind of vanilla is made from the eugenol of clove oil as a substitute for that obtained from the vanilla orchis.

Club. The modern club is a place providing companionship and relaxation for its members. The nearest approach to this idea in ancient times was the Roman bath, where people could gather for conversation in an atmosphere of ease.

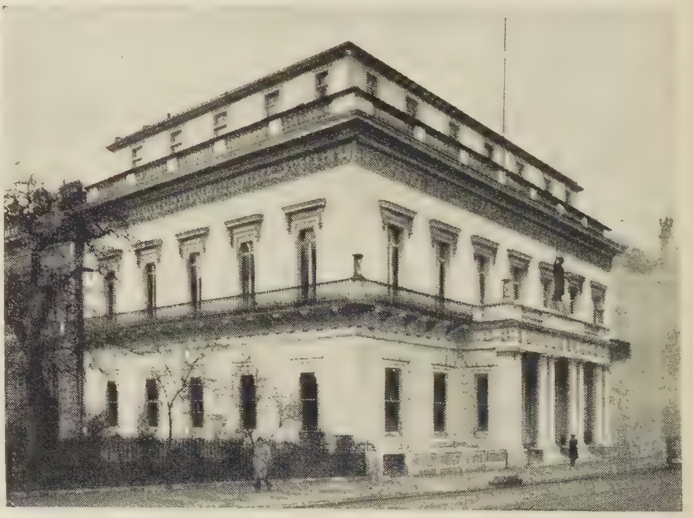
The word " club " to denote this kind of sociability first appeared in the 17th century. Says one writer : " We now use the word clubbe for a sodality in a tavern." In that century, too, coffee and chocolate houses became popular, sometimes serving as club headquarters. The famous White's Club started in this way in 1698.

By the early part of the 18th century clubs had become the fashion. People had discovered the charms of associating with kindred spirits and the pleasures of friendly argument. The saying " Birds of a feather flock together " was never truer. Political clubs abounded. Salt-water adventures were told and retold at the Royal Navy Club, the parent of the modern Service club. " The Sons of the Thames " was the pioneer of later aquatic clubs. Dr. Johnson founded various literary circles and the " Blue Stockings " provided a link between fashionable and literary society. It is rather sad to see the " Club of Ugly Faces " in the picturesque lists of this period, but perhaps its members found consolation by merely staring at one another.

In London there has arisen a whole neighbourhood (centred on Pall Mall and St. James's Street) almost entirely devoted to large clubs for men. Many of them, besides the usual lounges, bars, and dining-rooms, have libraries, bedrooms for out-of-town members, billiard rooms and the like, and several possess their own swimming baths.

Most august and famous of all is the Athenaeum (*never* attach the word " Club " to its title), founded in 1823. Here bishops, generals, governors-general, scientists, senior civil servants, and men of similar status congregate. Others among the better-known clubs are the Bath, Boodle's, Brooks's, the Carlton, the Garrick, the Reform, the St. James's, the Savage, the Savile, the Travellers', the Turf, and the United Universities. Among women's clubs are the Ladies' Carlton, the Forum, the Three Arts, the University Women's, and the Women's United Services.

Clubs for young people serve the same purpose of providing pleasant companionship as do those for their elders. The first youth clubs were run by philanthropists, who wished to defend children from the ignorance and cruelty that allowed them to remain idle, uneducated, and uncared-for. Towards the end of the 18th century Hannah More started a Sunday school for children belonging to the Cheddar district, where she lived. This proved so popular that she followed it with week-day schools for reading, sewing, and knitting, out of which parents' and old pupils' clubs automatically grew. To gain some idea of how these children had hitherto occupied their leisure time, one can turn to Miss More's account of how she persuaded her neighbours to lend their support to her work : " I said I had a little plan which I hoped would secure their orchards from being robbed, their



THE ATHENAEUM, A FAMED LONDON CLUB

At the corner of Pall Mall and Waterloo Place, London, is the Athenaeum, founded in 1823. The frieze of the building is a copy of that of the Parthenon at Athens. Persons eminent in public life, science, the Civil Service, literature, and art are eligible for membership.

rabbits from being shot, their poultry from being stolen . . ."

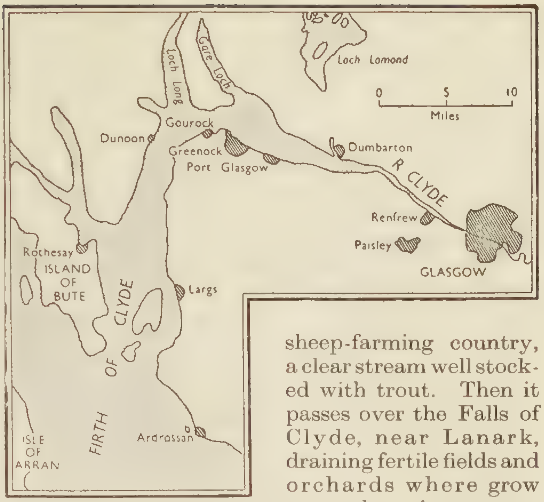
In 1780 Thomas Stock, a curate, co-operated with Robert Raikes in opening four schools in Gloucester for "tough" children. When told that his task was probably hopeless, Raikes replied: "These boys may be weeds . . . but who can tell ? —the weeds may become flowers. And I . . . am botanising in human nature." Raikes's venture was virtually the beginning of the national Sunday-school movement.

The obvious way to help children at this period was by education, or at least by teaching them to read. But when compulsory schooling was introduced by law, the function of the youth club changed. True, it still had to set up friendly centres which would offset bad social conditions and the loneliness of young people living away from home. The Y.M.C.A. (Young Men's Christian Association), dating from 1844, may be considered the oldest organization of this type, but it was quickly followed by clubs conducted by the various religious bodies. But soon the youth clubs began to furnish congenial occupations and creative outlets for their members. During the 19th century classes came into being that fostered old crafts and taught new accomplishments. Girls and boys learnt to dance, sing, make things, discover talents in themselves that they had never suspected or had the opportunity of exercising.

In 1908 Baden-Powell founded the Boy Scouts (see article). As it happened, he had no idea that he had started a movement which would spread through the world like a forest fire ; when he wrote *Scouting for Boys* he never dreamed that only one year later, in 1909, he would be confronted at the Crystal Palace rally with a band of "Girl Scouts" (*see* GIRL GUIDES). The Scout (and Guide) Law says : "A Scout (Guide) is a friend to all and a brother to every other Scout, no matter to what country, class, or creed the other may belong."

This quotation may serve as an apt summary of the essential objective of the typical youth club of the present day—in a word, fellowship.

Clyde, RIVER. To sail on a pleasure steamer "doon the watter" is the Glaswegian's joy. The water is Firth of Clyde, where Scotland's most important river, the Clyde, enters the sea on the west coast surrounded by mountain grandeur, 106 miles from its source. Rising in the southern uplands of Lanarkshire, it ripples through hilly



sheep-farming country, a clear stream well stocked with trout. Then it passes over the Falls of Clyde, near Lanark, draining fertile fields and orchards where grow strawberries, raspberries, tomatoes, apples, and plums. Soon the Clyde enters Scotland's "Black Country," an area of coal-mines and iron-foundries. Railway waggons and steel plates for ships and bridges are made at Coatbridge, Airdrie, Hamilton, Wishaw, and Motherwell. East Kilbride is one of the so-called "new towns," set up after the Second World War.

Farther down the river stands Glasgow, the largest city in Scotland. Nearly every industry is carried on in this vast workshop of the Clyde to the sound of clanging hammer and shrieking siren, but the most important is shipbuilding. At

LIBRARY OF A BOYS' CLUB IN HOXTON, LONDON

Youth clubs were originally founded primarily as schools for poor children who were running wild in city streets ; but when compulsory education was introduced by law, their function was changed, and they became recreation centres for boys and girls, and also provided them with facilities for learning a craft in their free time. Every club has a library, where members can read or enjoy a game of chess or draughts.

SHIPYARDS LINING THE BANKS OF THE RIVER CLYDE

Scotland's chief river begins as a trout stream and ends in a picturesque firth. But to most people the name Clyde calls up the idea of an important centre of shipbuilding which can turn out small tramp steamers, warships, and great ocean liners like the *Queen Mary*. Here is part of this vast, busy, and valuable workshop.

the beginning of the 19th century the Clyde was so shallow at Glasgow that it was possible to wade across. When trade with America began, the channel of the river was narrowed and dredged so that now by continual dredging the largest liners can sail to the centre of the city.

Downstream at Clydebank, and at Port Glasgow, Greenock, and Dumbarton are built large passenger liners, warships, and small cargo vessels. At Dumbarton the river widens, and becomes the Firth of Clyde. Standing sentinel is castle-topped Dumbarton Rock, which was a stronghold in Roman times. The estuary extends for 65 miles to Ailsa Craig (see article), a rocky islet rising abruptly out of the sea at the entrance to the Firth.

Sparkling blue sea-lochs wind, like the fjords of Norway, among the heather-covered mountains rising from its shores. Steamers sail by the islands of Cumbrae, Bute, and Arran, and call at the holiday resorts of Gourock, Dunoon, and Rothesay. Stretching far into the mountains to the north and west are the Gare Loch, containing Faslane, the naval station built during the Second World War; Loch Long, used in the past for testing submarines and torpedoes; the Holy Loch; Loch Striven; and the glorious Kyles of Bute. Broadening out still more, the Firth is enclosed for the last time between the ridgy green tableland of Ayrshire on the one side and the sharp peaks of the island of Arran on the other.

BURNING *the* SUNSHINE *of* LONG AGO

Coal. It is odd to think of sunshine coming from black stones dug out of the ground, but that is what happens when coal burns on a fire. Heat from burning coal is energy, and that energy was collected from the sun by trees and plants which grew long before man appeared on earth.

Hundreds of millions of years ago the world was much warmer, and the greater part of the land surface was covered with vast forests and huge jungles of giant ferns growing in swamps and shallow lagoons. Damp tropical heat made the earth like an enormous hothouse.

As the sun beat down, it set up chemical action, causing plants and trees to absorb the carbon, hydrogen, and oxygen that made them grow. When they died they fell into the swampy pools, where their remains accumulated in great beds. They did not decay completely, because of the acid in the water, but became covered by sand and silt, and so were cut off from the air and preserved.

Under the sun's heat the swamps became bogs, while the remains of the trees, ferns, and mosses were matted together and turned into peat. Peat (see article) is the first stage of vegetable matter in its conversion into coal, and there are large deposits of it in Russia, Ireland, Scotland, Canada, and the United States of America.

Most of the coal now being used is thought to have been formed during what geologists call the Upper Carboniferous periods, or between 200 and 300 million years ago. The shaping of the coal was slow and gradual, each stage in the process occupying several millions of years.

In those distant times the boundaries of land and sea were not so permanent as they now seem, and throughout millions of years new continents and seas were forming and old ones disappearing. Periodically there were great volcanic upheavals and the world was shaken by huge earthquakes. As a result great areas of forests, swamps, and peat bogs sank below sea level and were covered, first with water, and then with mud, sand, and the living shells of sea animals.

Geological Survey

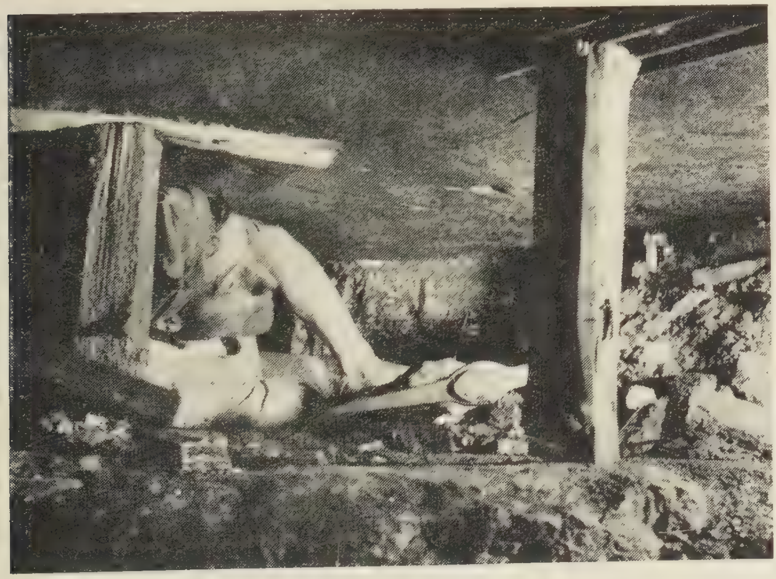
FERN INTO COAL

The shape of a fern that grew millions of years ago is seen on this piece of coal dug deep out of the ground.

Later the sea-bed was raised again by another volcanic eruption or earthquake, and a second tropical forest arose from the deposit of mud, sand, and shells. Time after time the sinking and rising of the land occurred, so that alternate layers of vegetation and mud were formed. Sometimes the peat bogs became the bottoms of lakes and shallow seas, at other times they formed parts of continents, and the shells on top of the peat became rock, some hundreds or perhaps even thousands of feet thick.

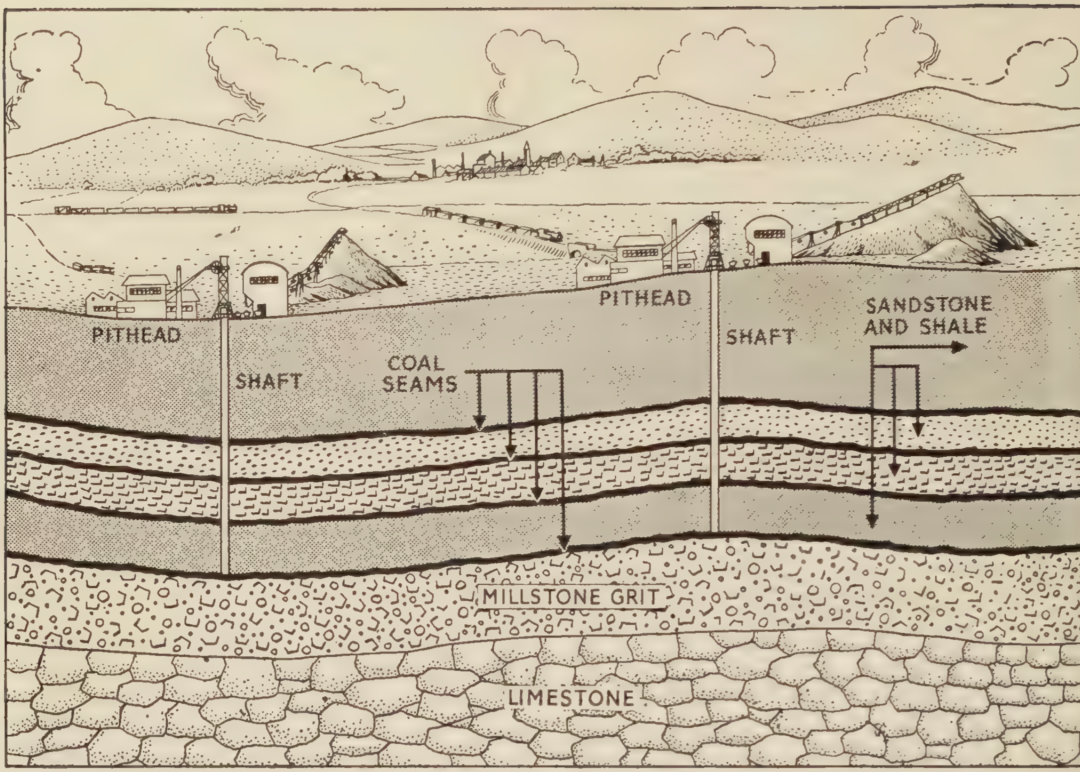
All these successive pilings-up of layers of peat and rock exerted tremendous weight or pressure on the peat, which was slowly pressed into hard, dry coal. This process forced out of the forming coal most of the hydrogen and oxygen but left the carbon. Pressure turned some of the oxygen and hydrogen into dangerous gases, quantities of which collected in hollows or pockets in the coal seams. The accidental explosion of such residual gases (*i.e.* gases "left behind") often causes disastrous explosions in coalmines.

Because of these geological changes, coal is found in seams sandwiched between layers of rock and shale. These sandwiches are called coal measures. The number of seams in a measure does not depend on its depth. In Staffordshire there are measures some 5,000 feet deep containing as many



LABORIOUS METHOD OF WORKING A SEAM

Where a seam of coal is very narrow, the coal has to be hewn with a pick, and in this instance the miner has to lie on his side because the seam is only 13 inches wide. The wooden props in the foreground are supporting the roof.



THIS IS WHAT IS UNDER A PITHEAD

This is what a colliery looks like above and below ground. On the surface are the pithead shafts with the winding gear for raising the coal and for taking the miners to and from their work. Next comes a thick layer of sandstone covering the first seam of coal ; then another layer of stone and a second seam of coal. Sometimes, there are as many as 40 seams of coal, but none is ever found under the layer of millstone grit, which usually lies on a layer of limestone.

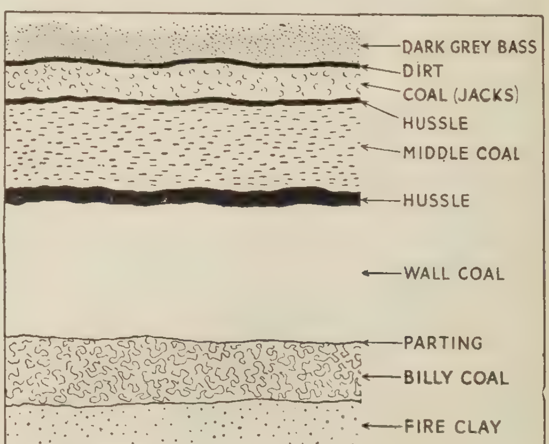
as 40 workable seams of coal, whereas in South Wales some of the measures are 10,000 feet deep but contain only 25 seams. Coal seams vary in thickness in different measures ; some are several feet thick, others only 18 inches.

The greater the pressure on the coal in its formation, the harder it is and the better it will burn, for little is left in it except carbon. Coal is called soft or hard according to the amount of gases that have been forced out of it. Soft coals are found nearer the surface than hard coals, which have been buried under successive layers of rock and therefore have been pressed harder and for a much longer time. Hence the best coal is nearly always found deepest under the ground.

Occasionally small deposits of good coal are found very near the surface, when it is called outcrop, or perhaps less than 100 feet below the surface, when it is called opencast (because it can be obtained by digging a trench instead of sinking a mine). These surface deposits are due to accidents like landslides or earthquakes.

Lignite (named from Latin *lignum*, wood), or brown coal, is peat in the first stage of turning into coal. It is a sort of cross between wood and coal, and some of it still has the impression of the ancient trees from which it is formed. Lignite consists of about 70 per cent. of carbon. and has a much higher fuel value than peat. Large quantities of it are mined in the U.S.A., Canada, Germany, India, Malaya, Japan, Australia, and New Zealand. The seams are often 20 or 30 feet thick ; at Morwell, in Victoria, Australia, there is one 265 feet thick.

When beds of peat or lignite were buried deep in the earth and were subjected to increasing pressure and higher temperatures (temperature increases with depth into the ground), further amounts of volatile materials (that is, materials



In this drawing, called a geological section, are shown the different kinds of rock found between the seams of coal. Wall coal is the chief seam, and is worked by the long-wall method, which is described in the text on page 449.

that evaporate easily) were driven off and a larger amount of carbon was left behind to form what is called bituminous coal. This exists in several kinds, classified according to their carbon content, which varies between 75 and 85 per cent. Most of the coal mined is bituminous. It is plentiful, comparatively cheap, and has a high fuel value, but it burns with a smoky flame unless properly controlled, and in manufacturing districts where it is used is apt to fill the air with soot.

There is one type of bituminous coal, called cannel coal, which contains less carbon and more gases than others of this group. It is called "cannel" (a corruption of "candle") because lighted lumps of it burn with a bright candle-like flame. Most of the coal burned in domestic grates is cannel coal, and it is also used for making gas (see article). It is mined chiefly in the British Isles and in Kentucky and Indiana, U.S.A.

Anthracite is the variety containing the highest percentage of carbon, amounting to as much as 95 per cent. It has been buried deep in the earth, and in addition to undergoing pressure by successive layers of rock it was tremendously compressed again when the strata containing it were folded into mountains. That is why most of the anthracite in Britain is found in mountainous districts like Wales. Because it contains very little volatile matter, anthracite burns with a nearly smokeless flame, while the fact that it glows and gives out heat for a long time makes it the ideal coal for use in boilers for generating steam. Anthracite is scarce and difficult to mine, so that it is too expensive except for special purposes.

National Coal Board

FRONT DOOR OF A MINE

The steel tower is above the mine shaft, which extends downwards to the level of the coal. The lift, which goes up and down the shaft, is attached to the steel cables passing over the two large wheels, and is operated by electric motors.

North America, Asia, and Europe have the world's chief coal deposits, about one-seventh of which are in North America. The coalfields of South America, so far as is known, are small and scattered, and few are worked except in Brazil, Peru, and Chile. Great Britain, Germany, Russia, and France are the principal coal-producing countries of Europe. Japan, China, and India lead Asia in production, and Siberia's reserves rank second only to China's. The Chinese fields are believed to be exceptionally rich, and with up-to-date methods and machinery would probably have an annual production rivalling that of the United States of America. South Africa, New Zealand, and Australia also produce much coal, and extensive beds have been found in the mountainous regions of Morocco and around Lake Nyasa in Tanganyika. Vast, but unmined, deposits exist also in Sarawak, in Borneo, and in Spitsbergen, in the Arctic.

Every year well over 1,500,000,000 tons of coal are dug up throughout the world, but there are still enormous quantities waiting to be mined. The world's coal reserves have been estimated at 7,000,000,000,000 tons at least, which at the present and future probable consumption is enough to last for 5,000 years. These almost astronomical figures mean that if all the world's available coal were spread evenly over Great Britain it would cover the whole of the land to a depth of 38½ inches.

Although Great Britain was one of the first and largest producers of coal and now mines an average of over 220,000,000 tons annually, it was thought until recently that so much coal was being raised that British deposits would be exhausted by the middle of next century. But careful surveys indicate that below the ground are 140,000,000,000 tons, enough to last for over 600 years at the rate it is being used at present. So there seems to be truth in the saying that Britain is made of coal.

Britain's chief coalfields are in South Wales, Durham, the Lowlands of Scotland, Yorkshire, Derbyshire, Nottinghamshire, Northumberland, Lancashire, Staffordshire, Warwickshire, Leicestershire, North Wales, Kent, Cumberland, Somerset, and Gloucestershire.

One legend has it that the burning quality of coal was accidentally discovered in China nearly 3,000 years ago. An iron smelter had dug a pit and lit in it a wood fire to melt some iron ore. To his surprise, the sides of the pit began to glow bright and red, and gave off a much greater heat

than the wood fire. What he had done was to light his fire on an outcrop of coal.

In time the knowledge of coal spread to ancient Greece and Rome. But for centuries only outcrop coal was used ; and even when methods of mining were discovered, output was small, because the workings became flooded and handpumps were not able to get rid of the water. So wood continued to be the chief fuel.

The primitive industries of those days used vast quantities of timber for fuel, and the ruthless cutting down of trees resulted in the destruction of most of the thick forests that once covered much of Britain. But timber was essential for building the ships on which England's prosperity depended, and for many other purposes. Far-sighted people therefore came to the conclusion that industries should be encouraged to burn coal instead of wood.

In 1234 the freemen of Newcastle were granted a charter to dig for coal, and eventually similar permits were granted for the opening of pits in various parts of the north and midlands of England. Most of the mines were not very deep, so that the coal obtained from them was of the soft varieties. Soft coal gives off thick smoke when burning, and this was very unpleasant in towns, so although people were encouraged to dig for coal it was only for use in industrial districts, and all sorts of penalties were imposed on citizens who burned coal in household grates.

Nevertheless coal was much more convenient to burn than wood, and as the art of mining developed, deeper pits were dug and better coal was obtained. In the reign of Edward III (1327–1377) most of the laws against the use of coal in towns were abolished, and by the time of Queen Elizabeth I coal came more and more into use both for households and for industry.

For a long time difficulties of transport limited supply to places near the pits or near to rivers and the sea. Thus "sea coal" (as it was called from its method of transport) from the northern and midland coalfields was in general use in London and the south and west of England. Not only London, but the Netherlands and other parts of the Continent of Europe were supplied with coal mined in Tyneside and Durham, so laying the foundations of the trade that made Britain for many years the world's largest exporter of coal.

Towards the close of the 17th century better pumping systems and improved methods of mining made it possible to increase production and cut costs. Nearly all industries turned over to the use of coal for fuel, and in the 1760s the general use of this fuel instead of charcoal for the production of iron made iron cheap and plentiful. Then, towards the close of the 18th century, William Murdoch (1754–1839) invented a process to extract from coal a gas suitable for lighting streets and houses (*see* GAS). So demand increased.

Between the middle of the 16th century and the end of the 19th century Britain's annual production increased from 190,000 tons to 9,500,000 tons. This supply of cheap coal was one of the factors that produced the Industrial Revolution which changed Britain from an agricultural country into "the workshop of the world."

But although coal made Britain wealthy, it made miserable the lives of the unfortunate people who mined it. Every lump raised to the surface had to be laboriously hacked out by pick and shovel and then dragged in trolleys, along galleries only a few inches high, to the bottom of the pit-shaft. Women and children were often employed in this work, crawling on their hands and knees with trolleys attached to their waists. No safety regulations were enforced in mines, and thousands of lives were lost because of explosions. Conditions were even worse in Scotland, where the miners were looked upon as part of the mine and were bought and sold with collieries almost like slaves.

It was not until the middle of the 19th century that the employment of women and children in mines was forbidden in Britain. About the same time safety regulations were enforced by the government and the miner's work made less dangerous. But it was only at the beginning of the 20th century that miners began to be paid wages in keeping with the hard and dangerous lives that they lead. Nowadays peoples and governments have come to realize what a fine and essential job the miner does, and that he has a right to certain privileges and to good pay to compensate him for his unpleasant task.

Most of the coal in the early days of mining was found by accident, but nowadays coal measures are scientifically searched for. Geologists, who have made a special study of rocks and their formation, can nearly always tell ground that seems likely to have

National Coal Board

PREPARING TO BLOW UP THE COAL

In certain circumstances the best way of attacking the coal face is to blast it. Holes are drilled in the coal face, into which explosive charges are inserted, the explosions bringing down the coal into the working gallery. Experts are always at work in seeking explosives safer to use than the old ones.

MINING COAL ABOVE AND BELOW GROUND

National Coal Board

If the coal lies close to the surface it is obtained by what is called the opencast method (top picture), the covering layer of earth and stone being removed with mechanical shovels. Coal from the seam is taken by a mechanical conveyor belt to the unloading point, where it is tipped into trucks or tubs (lower left). Electric engines haul trains of loaded trucks to the shaft (lower right), where the trucks go to the surface. Ponies are still used in some mines.

DIGGING A COAL MINE

Geologists have discovered coal underground, and this photograph shows the first step in sinking a shaft to the seams. Holes have been drilled around the centre of the concrete bed, and into the holes will be pumped a solution to freeze the earth and so stop water from seeping in while the shaft is being dug. See the explanation below.

coal seams underneath it. If the coal is lying close to the surface, it is obtained by the opencast method. The covering layer of earth and rocks is removed with mechanical shovels, and the coal at the bottom of the trench thus dug is broken up and lifted out by huge mechanical grabs, to be loaded into lorries or railway trucks. There are several opencast pits in Great Britain, and after the trenches have been emptied of the coal they are filled in again so that the ground can be used for agriculture.

When geologists decide that somewhere deep below ground there is a coal measure, the first task is to drill a borehole to find out how far down the coal is, how thick the seams are, and whether or not the coal is of good quality. The hole is sunk straight down into the earth by a drill consisting of a long steel tube a few inches in diameter and having at its end a ring of steel teeth tipped with diamonds. The tube is turned round and round by a steam or oil engine which forces it through the rock, sometimes to a depth of over 4,000 feet. As the drill cuts its way down, thin cylinder-shaped sections of the ground are forced up the tube.

If these sections show that a coal seam has been struck, shafts (wide circular pits) are sunk into the earth until the seam is reached. As the work of sinking the shaft proceeds, the sides are lined with concrete or bricks, or sometimes semicircular steel segments similar to those used for lining underground railway tunnels.

Very often the ground through which the shaft is sunk is so wet and soft that the sides fall in before they can be lined. One way of overcoming this is to drive boreholes round the edge of the site of the shaft and lower into them pipes six inches in diameter. Inside each of these another pipe, $1\frac{1}{2}$ inches in diameter, is lowered, and through these smaller pipes is pumped a solution of refrigerating chemicals (*see* REFRIGERATION) cooled below zero degrees Centigrade. A ring of ground is thus frozen solid, and inside this the soft, wet soil is dug out and the shaft lining put in.

When the shaft has been sunk to the level of the coal, the mine is then laid out by cutting at right angles a number of large tunnels or "roads" radiating from the shaft like the spokes of a wheel. From these are drilled other smaller tunnels leading at right angles to the actual coal face where the miners cut the coal. The coal is brought from the side tunnels to the main "roads," along which it is conveyed to the bottom of the shaft, where it is loaded on to the lifts or cages which bring it to the surface.

Once the general layout of the mine has been decided upon, a second shaft is sunk to assist in ventilation. This is done by drawing fresh air down one of the shafts and sucking out the stale air by means of fans at the top of the other shaft. The fresh air is blown through various roads or tunnels and the stale air is sucked out of another connected tunnel. Screens are built at points on the fresh-air roads to divert the air along the tunnels leading to the coal face itself.

Because of the danger of explosion from firedamp—a vapour consisting mainly of marsh-gas given off from the coal, which ignites when mixed with air and in contact with a naked flame—the safe lighting of mines is a difficult problem. Some are lit by electric lamps taking current from cables, but this cannot be done at the actual coal face as there is always danger that the wires may fire if struck and broken by a pick. At the coal face the miner must therefore wear or carry some kind of safety lamp. Many of these are electric, taking

their current from dry batteries carried by the miner. (*See* DAVY, SIR HUMPHRY.)

There are two main methods of digging out coal: the pillar and bord, and the longwall. The former consists in splitting up the seams into rectangular blocks or squares. Imagine a piece of the squared paper used for making graphs. Roads are driven through the coal at right angles to each other, corresponding to the lines on the squared paper. This divides up the coal into pillars, corresponding to the squares on the squared paper. The pillars of coal support the roof while the tunnels are being driven, and when the end of the coal has been reached and dug out, the miners work their way back along the road, cutting down the pillars.

In the longwall system a road is driven parallel with the seam so that the coal can be dug out all along the line. This method of working is used where the seam is not very thick, and it needs very careful propping to prevent the roof of the road from falling down.

Whether he is working by pillar and bord or by longwall system, the miner cuts out the coal by first driving a groove close to the floor, either into the coal itself or into the rock beneath the seam. The mass of coal above the groove is supported during the groove cutting by wood or steel sprags (props). When the groove is finished, the props are withdrawn. If the immense downward pressure of the rock above the seam is not enough to bring the coal down by splitting it along the groove, it is loosened either by driving in wedges or by blasting it with explosives. This latter process is called shot-firing. The fallen coal is then broken up into pieces small enough for easy handling. After the coal has been taken out, the space is filled up with rock and other waste. This process is called packing the goaf, or gob.

There has been a great increase in recent years in the use of machines for cutting coal. These consist of a steel band with rows of steel teeth on one side. Driven by electricity or compressed air, they move slowly along the ground, cutting a deep groove into the coal. Mechanical coal-cutters cannot be used where the floor or roof is uneven, or where the coal is very soft, because soft coal is apt to fall on to the cutter and put it out of action.

Ponies are still used in some mines for drawing the tubs or trucks of coal, but most collieries now have mechanical transport underground. Conveyor belts (*see* CONVEYORS) carry the coal from the face to the haulage road, where it is tipped into trucks running on rails and drawn by locomotives driven by electricity or compressed air. Sometimes there is no locomotive, and the trucks are attached to a steel rope winding over a drum operated by an engine near the bottom of the shaft. In some mines there are no rails along the haulage roads, and the coal is carried in low-built electric or diesel-engine waggons with pneumatic tyres. These can take a load of five tons.

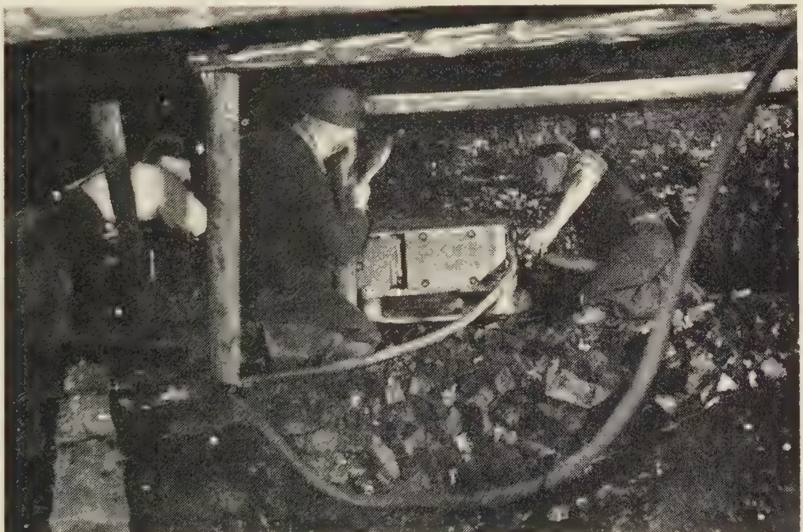
The tubs or waggons are run on to huge, fast-moving cages which hoist them to the surface. These cages also carry the miners to and from work.

At the pithead the coal is tipped on to screens, which grade it into different sizes. There are several of them, each having different-sized holes, so that several sizes of coal are separated from every truck load.

After grading, the coal is cleaned by removing from it unburnable rubbish such as shale, stone, pyrites, etc. Cleaning may be done by men who pick out the rubbish as the conveyor belts pass, or it may be done by washing. Washing machines work on the principle that coal and unwanted materials have different specific gravities; that is to say, they sink at different speeds in still water and are carried forward at different rates in running water. The washing machinery is so arranged that the coal and impurities are separated by water and fall into different containers.

Coal used as fuel is valued according to its heat energy, while coal used for making gas is graded according to the ease whereby its gas content can be extracted. (*See* GAS.)

The heat value of coal is measured by an instrument called a bomb calorimeter—a strong, circular, airtight container surrounded by water. A measured weight of coal is put into the container and burned in pure oxygen, so that the heat produced by the burning warms the water surrounding the container. The amount of water is known, and from the number of degrees whereby its temperature is increased can be calculated the number



National Coal Board

MINERS OPERATING A MECHANICAL CUTTER

Machines for cutting coal are being widely used, and have greatly increased the quantity of coal mined per man per shift. These machines consist of a steel band having rows of steel teeth on one side. Driven by electricity or compressed air, they move deliberately along the coal face, in which they cut a deep groove.

of heat units which will be released by the burning of a particular grade of coal.

Either of two heat units can be used to measure heat content. One is the calorie, which is the amount of heat needed to raise the temperature of one gramme of water one degree Centigrade. The other is the British Thermal Unit (B.Th.U.), which is the amount of heat needed to raise the temperature of one pound of water one degree Fahrenheit. Good anthracite coal has a heat value of 13,000 B.Th.U.s per pound.

The most wasteful (but cheerful!) way of using coal is to burn it in lumps on an open fire, when all the valuable chemical by-products will be lost. Treating coal by various processes yields gas for lighting and heating, fertilisers, tar, fuel oil, petrol, dyes, disinfectants, cleansers, antiseptics, phenol (from which are derived explosives, photographic developers, and certain plastics), saccharine, sulphur, synthetic rubber, and hundreds of other valuable materials. And when all these things have been extracted there still remains a solid fuel that can be used to generate heat energy.

Moreover, burning raw coal creates dirt in the form of soot, and for many purposes it is best to use processed forms of coal such as coke, which is coal after the gas works have finished with it. Even poor-quality coal can be used efficiently for heating by grinding it into a fine powder and burning it in boiler furnaces (*see* BOILER). Experiments have also been successfully made in converting coal into gas without taking the coal out of the mine.

FINDING OUT HOW HOT IT IS

Some kinds of coal give more heat than others when burning, and to find out how hot will be the heat of coal from a particular mine coal scientists use a calorimeter (an instrument for measuring heat). Here a sample is being tested for heating value at a Nottinghamshire colliery.

Coal-Tar. Somewhere about a century ago William Perkin discovered the first synthetic dyestuff, which he made from coal-tar chemicals. Until then coal-tar, a dark, evil-smelling liquid, had been regarded as a mere waste product of the making of coal gas, and a nuisance to the gasworks' owner. Every ton of coal that he burnt in his retorts produced about 120 lb. of this seemingly useless substance. But Perkin's discovery has led to the use of coal-tar as a rich source of valuable organic chemicals—dyes in great variety, explosives, antiseptics and drugs and insecticides, sweet-smelling essences, photographic chemicals, plastics and rubber-like materials, detergents, and a host of others.

Coal-tar is a complicated mixture of hydrocarbons—compounds of hydrogen and carbon. These compounds, the five most important of which are the liquids benzene and toluene, and the solids phenol, naphthalene, and anthracene, have different boiling points, so that they can be separated by distilling in vast cylindrical boilers, sometimes holding as much as 10,000 gallons of coal-tar. The quantities of each vary according to the temperatures and to the original coal used in the gasworks; but even the most abundant, naphthalene, amounts only to about six pounds in every ton of coal. The sticky liquid remaining after distillation is pitch, used for road surfacing, in roofing materials, and for preserving wood.

The five main compounds can be treated chemically in various ways to make a vast range of important substances. They can be oxidised; and if hot naphthalene is so treated, by passing air through it in the presence of a catalyst, a substance called phthalic anhydride is produced. This is a valuable material in making paints and dyes, such as indigotin. Another treatment is nitration, with a mixture of nitric and sulphuric acids. Benzene is transformed by this method into nitrobenzene and thence into aniline, which gives a splendid range of dyes for textiles and printers' inks. Treatment with sulphuric acid by itself turns the coal-tar chemicals into other materials for the dyestuffs industry. Chlorine added to benzene makes benzene hexachloride, a powerful insecticide; and these are but a few of the possibilities. Phenol forms the basis of "Bakelite" plastics, dyes, and many common antiseptics. Toluene is the source of trinitrotoluene (T.N.T.) and other powerful explosives—and also of the sweetener saccharine and some synthetic flavours.

Millions of people in all parts of the world owe a great debt to the chemists who have evolved synthetic chemicals from coal-tar. Not so long ago, for example, vast acreages of southern Europe and Asia Minor were devoted to growing madder, a plant giving red dye. The roots of this plant were fermented to give alizarin, the dye known as Turkey red. Then the chemists made alizarin from anthracene, and the

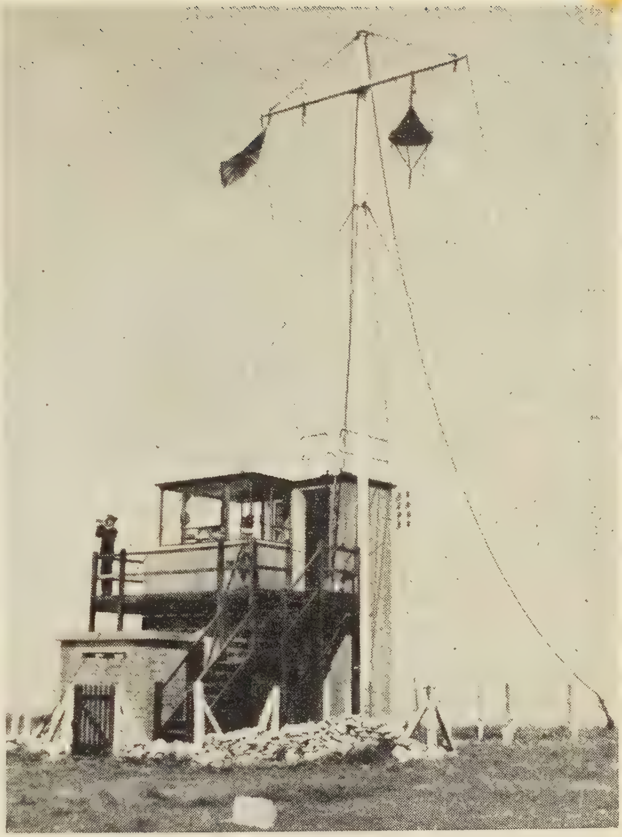
madder fields have been turned over to growing food. Much the same happened to the indigo plantations around 1900, when German scientists produced indigotin, a near-perfect substitute for the natural dye. Benzene hexachloride is to-day bringing the locust menace within bounds: this again means an increase in the world's food supplies. Homes and factories are cleaner through detergents and safer from infection by reason of the phenol-based antiseptics. New flavouring essences have provided sweeter-smelling soaps, and new explosives have made mining easier and safer.

In simple terms, what chemists have done is to use coal-tar as an easily available source of that most active element, carbon, and the product has become an essential chemical raw material.

Coastguard. Her Majesty's Coastguard keep watch over the 6,000 miles of the coasts of Great Britain and Northern Ireland to warn shipping against running into danger, to aid seafarers in cases of shipwreck and accidents at sea, and to watch for smugglers.

In times of national emergency the Coastguard, besides being a life-saving service, watch the coasts to ensure that immediate reports of the approach of enemy forces, or of other dangers from the sea, are made known to the appropriate authorities. They might, for example, report a drifting mine, or a wreck dangerous to shipping.

In normal times watch is kept from some 150 coastguard stations and the Coastguard are assisted in their life-saving duties by the Coast Life Saving Corps, a voluntary organization consisting of about 5,000 civilians living near the coast. Stations jointly run number 403. In addition to advising the lifeboats when their services are needed, the Coastguard operate the rocket life-saving apparatus.



COASTGUARD ON WATCH

In the photograph one of Her Majesty's Coastguard is keeping a watch on shipping from the station at Portland Bill, Dorset. A dark cone has been hoisted to warn shipping that a gale is imminent. The Coastguard maintain constant vigil over the 6,000 miles of the coasts of Great Britain and Northern Ireland.

Cobalt. In the early days of copper mining in the Harz Mountains of Germany, the miners often found that the smelted copper had been spoiled by pieces of an unknown and useless ore. They decided that this unwanted ore must have been put in the mines by goblins, so they called it *Kobold*, the German for goblin. In 1735 George Brandt, a Swedish chemist, discovered that *Kobold*, or cobalt, was a chemical element.

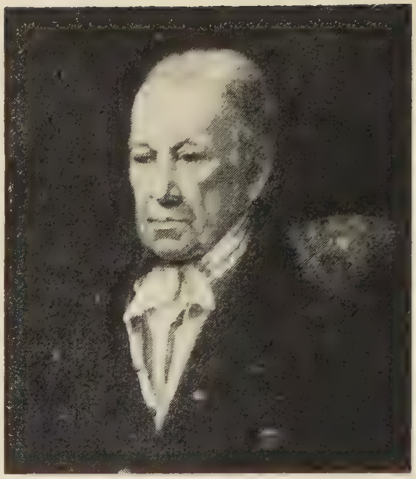
A white metal, cobalt is a close relative of iron and nickel. Its symbol is Co, and its atomic weight 59. It is harder than nickel, is magnetic, and does not rust easily. It is chiefly obtained from copper ores, and most of it comes from the Belgian Congo and Northern Rhodesia. It is also found in Morocco and Burma. Total world production amounts to about 12,000 tons a year.

By itself, as the German miners found, cobalt is useless for making metal articles. Its early use was as a blue pigment for stained glass and for making blue, green, and pink enamels and paints. But the modern development of alloys has made cobalt a very important metal indeed. Its high melting point makes it ideal for use in steel alloys which are subjected to very high temperatures, for example, in jet engine parts. Certain metal cutting tools for high-speed work are made from alloys of cobalt, chromium, and tungsten. Still better for this purpose are alloys of tungsten carbide and cobalt, which have a diamond-like hardness and make wonderful tips for hand-drills. The chief use of cobalt is in making magnets; it is mixed with certain irons to produce magnets able to lift 60 times their own weight. A mixture of the metal with iron, nickel, and manganese made possible metal envelopes for radio valves. This alloy expands when heated, as does glass.

Small quantities of cobalt in pasture-land help sheep and cattle to get the best food value from the grass. Human bodies also need cobalt, though only in very small amounts.

Cobbett, William (1762–1835). "The pattern John Bull of his century": so Carlyle described William Cobbett. But this farmer's son who became the champion of the oppressed working classes of his time was something more than a blunt Englishman fighting in politics. He was also a fine writer. He had almost no education, and taught himself grammar when he was a young soldier. He learned to write so clearly, vigorously, and vividly, that his best-known book, *Rural Rides* (1830), brings the England of his day to life.

Cobbett was born in Farnham, Surrey, and after a short career as a soldier he settled in America, teaching English to French emigrants who had fled there from the Revolution. There he began to write pamphlets attacking revolutionary ideas, and wrote so bitterly that twice he was prosecuted for libel. In 1800 he thought it wiser to come back to England, where Pitt offered him the editorship of a government newspaper. But Cobbett insisted on remaining indepe ıdent, and so in 1802 he started his own paper, the *Weekly Political Register*, which he edited till his death.



WILLIAM COBBETT

Cobbett had hoped to become a political reformer, but he did not enter Parliament until he was too old to make an impression. Of his books, the best known is *Rural Rides.*

South London Art Gallery

Gradually his politics became Radical, and the *Register* became a fierce opponent of the government. Cobbett was often in trouble for his outspoken attacks, and in 1810 was sent to prison for two years and fined £1,000 for writing in support of some soldiers who had mutinied. He came out penniless, and had to sell his farm and several business enterprises. One of these was a paper that reported parliamentary debates. It was bought by the printers, Hansard, and eventually became the official parliamentary report now known as "Hansard."

In 1817 Cobbett went to America again to avoid trouble, and sent his articles for the *Register* across the Atlantic. But he soon came back to the fight, and in 1832 was elected to Parliament. As an M.P. he was not specially successful, and three years later he died—but in that time he had achieved a great deal. In the English countryside where he had lived, a labourer's grandson, he understood the terrible hardships that the country people were suffering in those times of great change. And he spoke up boldly for those people who could not speak for themselves.

Though in the end he was speaking for the factory workers as well, he always remained at heart a countryman. He wrote several other books, including a history of the Reformation in England, an English Grammar, and *Advice to Young Men*; and in all of them can be seen the vigorous, practical character with its strong likes and dislikes, that made him many enemies as well as many friends—the qualities that bring to life in his writing both the colourful personality that he was and the difficult times that he lived and battled through.

COBDEN AND BRIGHT

Richard Cobden (right) and his fellow worker John Bright (left) took the leading part in the agitation for repeal of the Corn Laws, with a view to the removal of taxes on the people's food, especially bread. Cobden's public-spirited work is commemorated in the busy London district of Camden Town by a full-length statue.

Cobden, Richard (1804–65). Most people are interested in their own trades, and in laws which make it easier or harder for them to earn a living; but a few people are just as interested in all trades and their prices and regulations and in how they affect one another—which is the study of economics. Richard Cobden was one who, not content with making money himself, wished to see everyone fairly paid for work done.

Cobden's father died when his son was still a child on their farm near Midhurst in Sussex; and Richard worked hard, first in his uncle's warehouse and then as a commercial traveller, before he and two friends bought a calico-printing business, in 1831. He was very successful in it, and could have made even more money, but he preferred to spend a lot of his time studying economics in Britain and America, and travelling in the Near East, where he formed opinions about British foreign policy which were to get him into trouble.

Coming home to Manchester, he took part in local politics and in the movement supporting cheaper education for everyone: and there he met John Bright (see article), who became his close friend and ally. In 1838 Manchester merchants began to agitate against the law that taxed foreign corn coming into Britain and raised the price of bread in those difficult times. Cobden became leader of the national Anti-Corn Law League. In 1841 he was elected to Parliament, where he carried on the fight so magnificently that after one of his speeches his opponent, Peel, the Tory prime minister, is said to have thrown down his notes and said to his colleague Sidney Herbert: "You may answer this, for I cannot."

By 1845 Cobden had won his battle, and Peel undertook to end the Corn Laws gradually over

three years. Meanwhile Cobden had neglected his own business and was penniless, but a public subscription raised £80,000 for him ; and after buying his birthplace, Dunford Farm, he travelled round Europe, fostering the cause of free trade and peace. Unfortunately, war panic was then growing in Britain, and when Cobden returned in 1853 and wrote pamphlets attacking it, he lost all his great popularity, also his seat in Parliament. In 1859 he was re-elected, and was offered a Cabinet post by his old enemy Palmerston. Cobden refused, because he had always disagreed with Palmerston's policy—but he worked hard organizing a trade treaty between Britain and France, and in fostering peace and international understanding, until his death.

Though as an economist he minded everybody's business, Cobden was so completely opposed to interference with personal liberty that he even disliked the law that controlled the employment of women in coal-mines. Many of his economic theories have been proved wrong, partly because of changing conditions and partly because Cobden always supposed that, given the chance, everyone would be as honest and as just as himself. But in his work for peace alone, he was a great leader, and the wisest statesmen of both Britain and Europe had the greatest respect for this courageous figure whom the French foreign minister described as "truly an international man."

Cobh (pron. kōv). Formerly known as Queenstown, Cobh is the outer port of Cork, Republic of Ireland, lying on the harbour at about 13 miles south-east of the city. There are large areas of docks on Haulbowline Island, and Cobh is a port of call for Atlantic shipping services, besides having direct connexion with several ports in Great Britain. The cathedral is built of granite in the Gothic style and was completed in 1916. The population in 1951 was 5,713.

Cork harbour, on which Cobh stands, is formed by the estuary of the Lee. It has dry docks, patent slips, and over 3,000 feet of quays, and contains several islands. Great Island divides it into the Inner Harbour and the Outer Harbour. Haulbowline was the chief Irish convict station from 1847 until 1885.

Cobra. The name *cobra de capello* (Portuguese for "snake with a hood") was first given to an Indian poisonous snake. Its shortened form, cobra, is now properly applied to a number of snakes found through most of Africa and through tropical Asia as far as Malaya and the Philippines. The skin around the neck is loose and the ribs here are extra long. By raising them the cobra spreads its hood, rather as one might spread a fan. It normally does this only in fear or in anger. The Indian cobra's hood often has markings like a pair of spectacles but in most kinds the marks are less clear and definite.

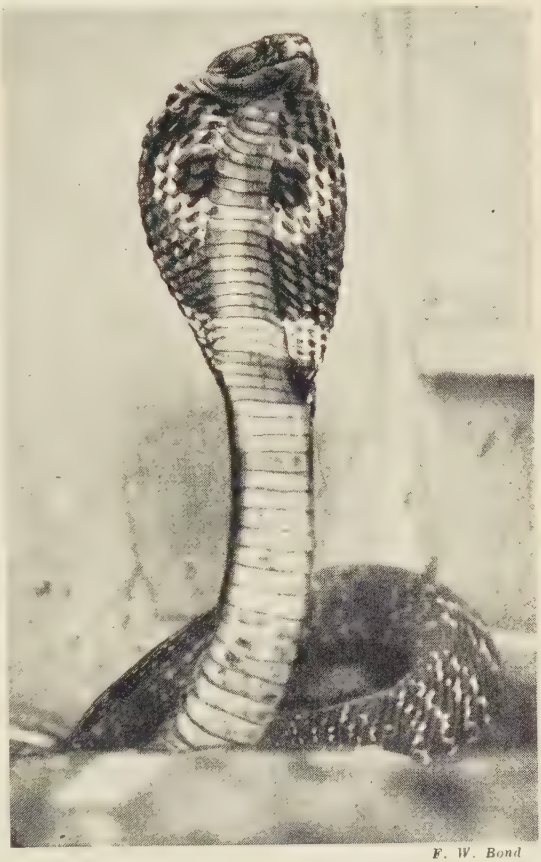
Like their close relatives the mambas, all cobras lay eggs and they often guard the place where these have been laid. Most of the stories about cobras making attacks on people or domestic animals probably have to do with snakes which are guarding their breeding territory.

The bite of a cobra can be very serious but does not always result in death, especially if treatment is given quickly. Most bites are given by accident when a snake is cornered and frightened, or trodden on. The real purpose of the poison fangs is to kill the snake's victims quickly. Cobras take many sorts of prey—lizards, frogs, birds, small mammals, other snakes, and even fish.

The many species of cobra vary considerably in colour. The Indian cobra may be anything from black to yellowish-brown, and it commonly reaches six feet in length. The Egyptian cobra, from the semi-deserts, and the black cobra, from the tropical African forest, are considerably longer snakes, reaching about 9 feet, but this is nothing compared to the notorious king cobra or hamadryad (*Naja hannah*), which is sometimes over 16 feet long and is certainly by far the longest and heaviest poisonous snake in the world. It is found from India through Malaya to the Philippines, and it feeds almost entirely on other snakes.

Several kinds of cobra, especially the black-necked cobra and the ringhals from Central and South Africa, are called "spitting" cobras because they can spray a fine stream of venom at anyone they regard as an intruder. This was long thought to be a spitting action, but it is now known that the poison is squirted from the tiny holes near the tips of the fangs.

Many kinds of snake have been worshipped in



F. W. Bond

INDIAN COBRA READY TO STRIKE

The most remarkable feature of the deadly cobra is its hood formed by the ribs of the neck, which the snake can raise and spread at will, expanding loose skin. The Indian species varies in colour from black to yellowish-brown

the course of history, but especially the cobra. Pictures of the cobra, with hood spread, can be seen on Egyptian monuments, and an Indian cobra is said to have sheltered Buddha from the sun. In India many folk still regard cobras as sacred and refuse to kill them, even though they are responsible for very many of the 20,000 deaths thought to be caused annually by snake bite.

Cochineal. In most well-stocked larders there is a little bottle of crimson essence labelled "cochineal." The housewife uses this to colour the icing on birthday and Christmas cakes. Cochineal is also used as colouring matter for sweets, medicines, and cosmetics, because it is not poisonous.

Cochineal is extracted from the dried bodies of certain species of scale insect, native to Mexico and Peru. These insects are so small that it takes 70,000 to weigh a pound. They belong to the order *Hemiptera*, feed chiefly on a species of cactus called nopal, and are cultivated on large plantations of this cactus. Enormous numbers of eggs are hatched, and when the females of the second generation are just ready to lay their eggs they are brushed off the plant, gathered in trays, and placed in a hot oven or put in boiling water. They are later dried thoroughly in the sun. The cochineal insect (*Dactylopius coccus*) was once successfully cultivated in southern Spain, Algeria, and Australia, but the plantations have been abandoned everywhere except in Central America. This is because cochineal, used for centuries as a natural dye for scarlet, crimson, orange, and other tints, has been replaced by the man-made aniline dyes. (*See* DYES for further information.)

Cockatoo. Formerly in some demand as a household pet, the cockatoo is nowadays rarely seen outside aviaries. It is not found as a wild bird in Great Britain. Together with the parrot, because of certain physical similarities, it belongs to a vast order of birds known to scientists as *Psittaciformes*. The cockatoo's true home is the Australian continent and the land masses associated with it. Here many different species are to be found, ranging in size from the great palm cockatoo (*Prosbosciger atterrimus*) of the Aru Islands, New Guinea, and Cape York to the little corella or bare-eyed cockatoo (*Kakatoe sanguinea*) of the drier regions of Western Australia.

The colour of the plumage varies greatly. The "Major Mitchell" cockatoo (*Kakatoe leadbeateri*), named after the famous explorer, is pink with an ornate crest and probably the most beautiful of all. For this reason it is becoming rarer. But on the other hand, the galah or rose-breasted cockatoo (*Kakatoe roseicapilla*) is abundant in most parts of its wide range, as also is the white species with the familiar sulphur crest (*Kakatoe galerita*). In fact, flocks of such cockatoos do a great deal of damage to wheat and maize crops, and farmers treat them as pests.

Australian aborigines are able to work great havoc amongst these cockatoo flocks with their peculiar throwing sticks, or boomerangs (see article). Eggs of all the cockatoos are white, and almost always the birds nest in tree hollows or "pipea" boughs. The young are helpless for many weeks. These birds live long; and one white, sulphur-crested specimen, "Cocky Bennett," of Tom Ugly's Point, Sydney, achieved world fame by living in captivity for 110 years.

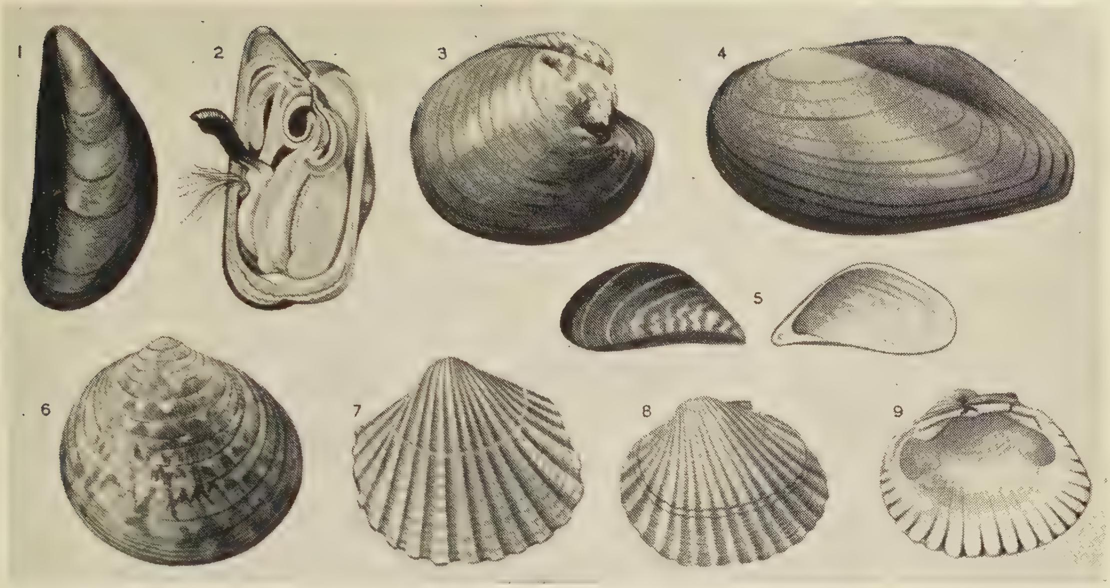
Cockles and Mussels. These are molluscs of the bivalve type; that is, they have two shells connected by a muscular hinge. The common cockle, *Cardium edule*, burrows in the sand under water, extending a curious siphon tube to the surface of the sand or mud, through which it draws water and sifts out the tiny sea creatures on which it feeds, as well as extracting the oxygen which it breathes. This habit causes the little spring-like spurts of water which are so often noticed by bathers and paddlers in sandy pools on the seashore at low tide.

The burrowing apparatus of the cockle, which it uses with great skill and speed, especially when young, consists of a so-called foot, which projects from the shell at the end opposite to the siphon. The cockle also uses this foot in another way. When the tide comes in and covers the sand, it comes out from its burrow and, by sharply bending its foot, moves along in a series of leaps. The cockle lays an immense number of eggs, which float about in the sea until they hatch at the end of a few hours. The young swim near the surface for a time, but after a few days take up life on the bottom, and presently start to burrow to escape from the crabs, eels, and starfish, which devour them in great quantities. Cockles are a valuable human food. They occur in the Atlantic, Pacific, and Indian oceans, and are sometimes very plentiful; an acre of sandy shore may contain about one-and-a-half million.

The gaper, or soft-shelled clam, as it is also called, *Mya arenaria*, is a much larger shell-fish

COCKATOO WITH CREST ERECT

Related to the parrots and native to Australia and adjacent islands, the cockatoo is distinguished by a crest of feathers, which it can raise at will and expand like a fan. Cockatoos thrive in captivity and live to a ripe old age.



SOME COCKLES AND MUSSELS AND THEIR SHELLS

These are shellfish of the bivalve type; that is, each has two shells connected by a muscular hinge. 1. Common mussel (*Mytilus edulis*). 2. Common mussel opened. 3. Heart cockle (*Cardium isocardia*). 4. Swan mussel (*Anodonta cygnea*). 5. Zebra mussel (*Drussena polymorpha*). 6. Dog cockle (*Pectunculus glycimeris*). 7. Prickly cockle (*Cardium echinatum*). 8. Common cockle (*Cardium edule*). 9. Interior of shell of common cockle.

which burrows, breathes, and feeds in a similar way, but prefers a more muddy shore. It is not eaten in Britain, but in North America, where it is also common, it is both eaten and used as bait. When alarmed it draws in its siphon tube suddenly, and at low tide this causes a spurt of water which betrays its hiding-place.

The mussel, *Mytilus edulis*, belongs to a different family of bivalves. Unlike the cockle, it does not burrow, but fastens itself to rocks, piers, and other suitable places by means of a bunch of very tough fibres known as the byssus. One species of mussel is edible, and is eaten and used as bait in huge quantities both in Great Britain and in other European countries, but not in America, though it is equally common there.

Fresh-water mussels, which are common in British lakes and rivers, are not true mussels. They are not eaten, but one species used to be valued because of the pearls contained in its shell, until the larger and more beautiful pearls of the pearl oyster were brought to Europe. Great quantities of the shells are used for making mother-of-pearl buttons. These mussels belong to the genus *Anodonta*.

The largest shell-fish is the giant clam, *Tridacna gigas*, of the coral islands in the Pacific. These creatures are said to live from 60 to 100 years, and their shells often weigh 400 lb. or more. Their meat is eaten by the natives of those regions, who formerly also used the shells to make axes and other primitive weapons. The shell closes with such a strong grip that a man may be held by the leg by one of them and then be drowned by the rising tide.

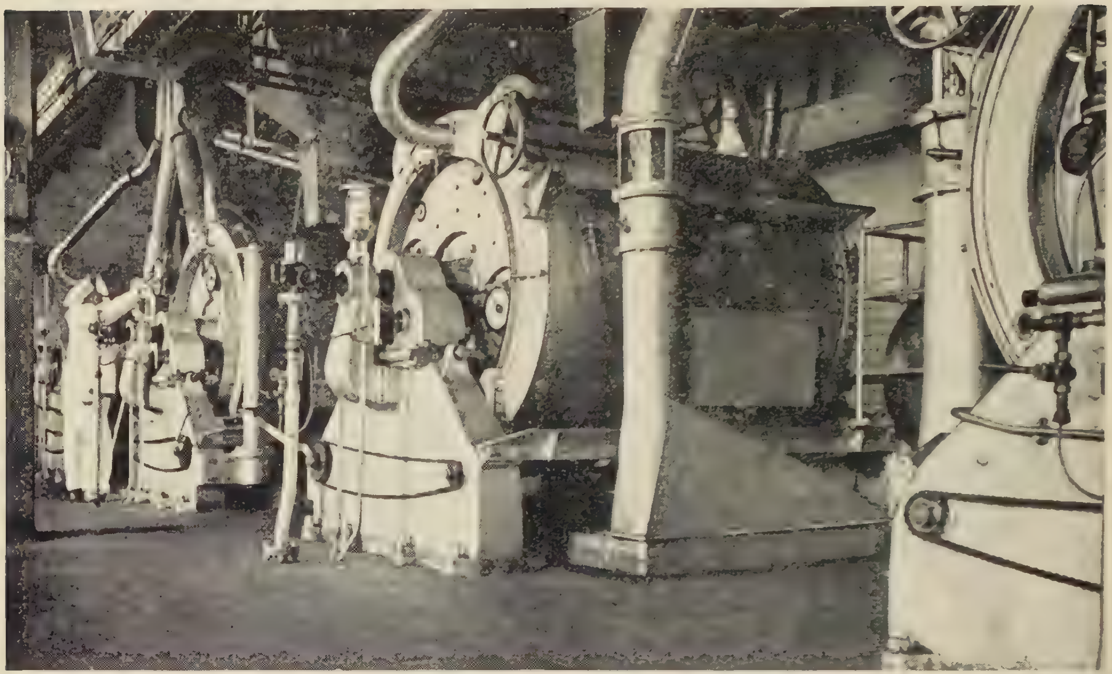
Cockney. Strictly speaking, a Cockney is a Londoner "born within the sound of Bow bells"—that is, the bells of St. Mary-le-Bow, Cheapside. The word originally meant "cock's egg," and at first the term was applied to any fool, then by countrymen to townsmen, and finally, from early in the 17th century, by countrymen to Londoners.

The educated Londoner is not now called a "Cockney" any more than the educated Tyne-sider or Liverpudlian is called a "Geordie" or a "Scouse" (except perhaps in fun). When the *Edinburgh Review* called John Keats "a Cockney poet" it was being intentionally insulting. Yet the typical Cockney often has a quick wit, a cheerful manner, and a way of getting things done.

The accent is distinguished by the mutilation of vowels and the dropping of consonants. The long *a* becomes a long *i*; the long *o* as in "no" becomes "ow" as in "now," and so on. The initial *h* and final *g* are usually dropped, and even a *t* in the middle of a word disappears, so that "light-house" becomes "loi'ahse." But this is extreme Cockney. Rarely now does one hear: "Paw li'l gel; she ain't sowld naou flahs the 'ole dye." However, the "i" for "a" (or a trace of it) infects the speech of many Londoners who are by no means out of the extreme lower ranks.

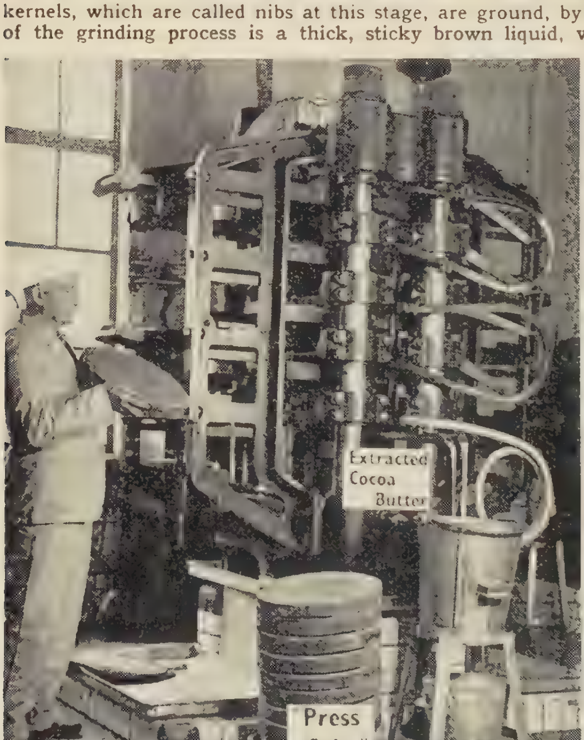
Cockroach. As members of the same order, *Orthoptera*, cockroaches are close relatives of the grasshoppers, locusts, crickets, and mantids, though they look more like beetles, and are often wrongly called "black beetles." Cockroaches have broad flat bodies which enable them to crawl about between walls, in cracks, or along water-pipes. They have long, powerful legs and can run rapidly. Each leg is armed with spines pointing backwards which serve as weapons. When attacked, they move backwards upon their foe and startle it with a shower of kicks. Their antennae, or feelers, are very long, often as long as the body, and very slender. The male common cockroach has large wings, while the female has

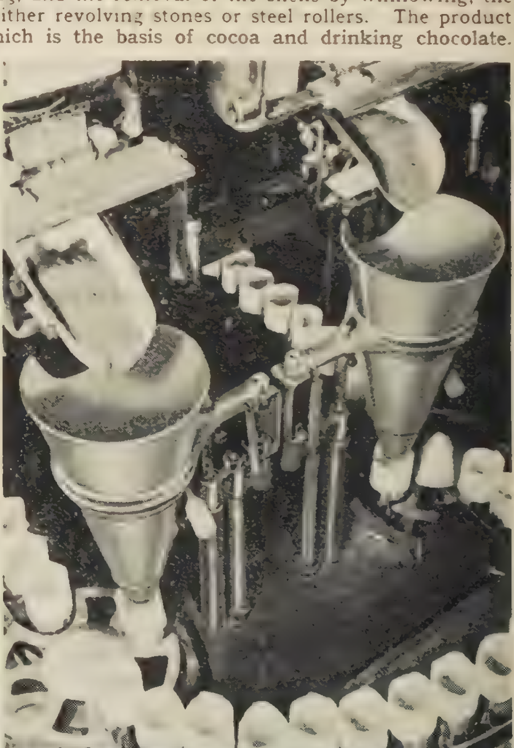
GETTING THE BEST FROM THE COCOA BEANS



Cadbury Bros., Ltd., Bournville

At the factory the dried beans are roasted in heated drums, seen here a process which develops the characteristic aroma. Each drum holds half-a-ton of beans. After roasting, and the removal of the shells by winnowing, the kernels, which are called nibs at this stage, are ground, by either revolving stones or steel rollers. The product of the grinding process is a thick, sticky brown liquid, which is the basis of cocoa and drinking chocolate.



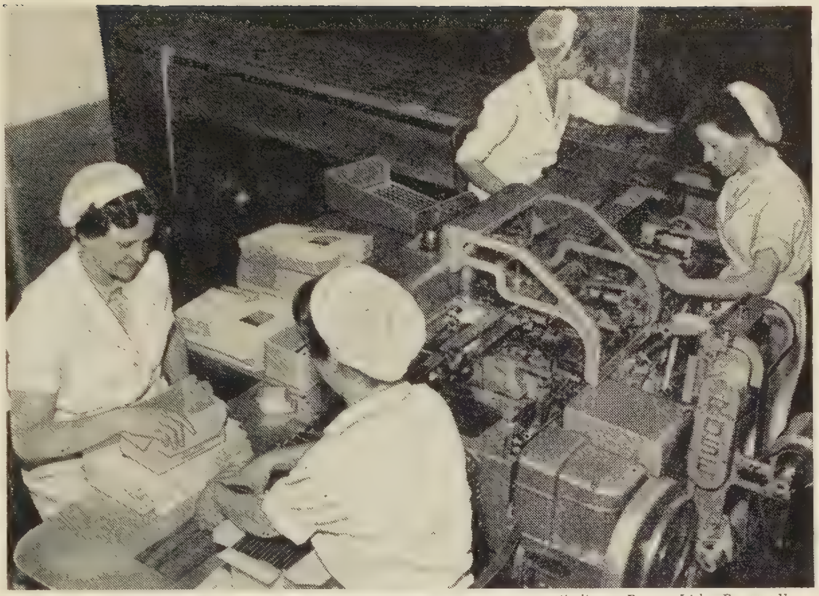


Cadbury Bros., Ltd., Bournville

Cocoa is made more palatable by the removal of the natural fat, called cocoa butter. This is done by hydraulic presses (left picture). The butter is subsequently used in the manufacture of slab chocolate. The semi-liquid ground cocoa leaves the press in the form of hard cakes, which are ground to a fine powder. Electric weighing machines pour the exact amount of cocoa into each paper-lined tin as it passes along beneath the funnel (right picture).

only small ones or none at all. One common form, *Blatta orientalis*, is of a dark, shining brown colour, but other colours are found, one species, *Panchlora*, being bright green.

Indoors, cockroaches lie hidden in the day-time, and come out to run about and feast at night. So greedy are they that they have been known to bite through book covers to get at the paste beneath. The mess and smell they leave behind them ruins food they have run over. Cockroaches are best got rid of by poisoning or by trapping in various ways. Among the earliest forms of insect life to appear on earth, cockroaches have changed little in millions of years, as their fossil remains show.



Cadbury Bros., Ltd., Bournville

WRAPPING CHOCOLATE

The refined chocolate is poured into moulds, which pass over a mechanical shaker in order to level the warm paste and to remove air bubbles. Next, the moulds pass through the cooling chamber. In the background cooled blocks are entering the wrapping department, where they are passed to a wrapping machine (right centre).

HARVESTING COCOA PODS IN GHANA

The pods are the fruit of the cacao tree, and within each one there are between 20 and 40 beans—cocoa beans which are surrounded by a sweet, white or pale heliotrope pulp. The beans, rich in protein and fat, are the basis of the cocoa and chocolate industries.

Cocoa and Chocolate.

Although cocoa is not as widely drunk as tea and coffee, it is the only one of these three drinks that is really nourishing. The bean or seed of the cacao tree, from which cocoa, drinking chocolate, and chocolate confectionery are made, is rich in protein and fat. The bean also contains the same stimulant, caffeine, as is found in tea and coffee. To some tastes the beverage is sickly and revolting; but it is a comforting thing after a cold spell of duty.

The cacao tree, *Theobroma cacao*, of the family *Sterculiceae*, is a native of Trinidad and the valleys of the Amazon and Orinoco rivers, in South America. The Aztecs prepared a chocolate drink from the bean, and the Spanish explorer Cortés found it being used for this purpose in Mexico in the early 16th century. But their drinking chocolate was apparently unsweetened, and no doubt far less pleasant than that which caused the great 18th-century botanist, Linnaeus, to give the tree its botanical name *Theobroma*, " food of the gods."

Columbus took beans of the cacao tree to Spain, and chocolate later became a fashionable drink at the court of the French kings. It is not known when sugar was first used with chocolate, but it

was probably the sweetened drink that found so much favour when it was introduced to England in the middle of the 17th century. It had become popular in Europe and England by the early 18th century. Some famous London clubs (see article) had their beginnings in the chocolate and coffee houses that were set up during this period.

To many people, however, chocolate was too rich a drink, because it contains so much fat. Cocoa was first made by Van Houten in Holland, in 1828. He discovered a method of pressing some of the fat—cocoa butter, as it is called—out of the beans, and in this way produced cocoa powder. Van Houten mixed his cocoa with flour or arrowroot to make it less rich. Nearly 40 years passed before the English firm of Cadbury began to produce a pure form of cocoa powder, which made this drink increasingly popular.

The eating chocolate familiar to-day was not made until the 19th century. It was made first in slab form; chocolate-covered centres and biscuits came later.

The cacao tree is much cultivated in Mexico, Ecuador, Venezuela, Brazil, Cuba, Haiti, San Domingo, Trinidad, Jamaica, West and East Africa, and Ceylon. It is an evergreen about 20 feet high. The fruit is a pod, green at first and a purplish yellow when ripe, which grows in clusters direct from the stem of the tree. Each pod contains from 40 to 60 seeds, or beans.

When the beans have been extracted from the pod, they are allowed to ferment in order to improve the flavour, which at first is rather bitter. They are then dried in the sun, or artificially in hot air, until they are rich brown. At the factories they are roasted in revolving drums, and crushed between rollers into small pieces called nibs, which are separated from the husk of the bean. The nibs are next ground between further sets of rollers. The heat caused by the friction melts the cocoa butter in the nibs, and the result is pure chocolate, a sticky brown mass which is the basis of cocoa, drinking chocolate, and chocolate confectionery. The best flavours are obtained by blending nibs from different types of bean.

Sweetened chocolate for drinking is made by adding sugar. For cocoa, about half the cocoa butter in the liquid is pressed out, and the rest dried into hard cakes for crushing.

Cocoa butter, which is removed in the process of making cocoa, is used to make slab chocolate and chocolate confectionery, by adding it to the original liquid together with sugar and flavourings. This liquid mass is ground together in a machine (a *mélangeur*) in which heavy granite rollers revolve on a revolving granite bed. The mixture is then delivered to a refining machine where it passes between rollers revolving at different speeds. Then the chocolate is further refined in a trough (called a "conche") where the mixture is pommelled for hours by granite rollers until it is reduced to a smooth, velvet-like consistency. This chocolate may become either slab or confectionery chocolate. To make slab chocolate the mixture is poured into

DRYING COCOA BEANS IN WEST AFRICA

The cacao tree is native to tropical America, but is now cultivated in many countries with a hot, moist climate, such as Ghana and Nigeria. After the beans have been extracted from the pod they are allowed to ferment and so to acquire a finer flavour. They may then be dried in the hot tropical sunshine, as seen in this photograph.

mechanically-operated moulds where it is cooled, sets, and can easily be removed. Chocolate covering for biscuits and chocolates has a higher proportion of cocoa butter added to it, so that it may flow freely over the prepared "centres." These confectionery "centres" and biscuits are usually covered with liquid chocolate by "enrobers," in which the centres or biscuits are passed through the mixture on wire trays, and then into moulds which stamp them with a design. More expensive chocolate confectionery may be covered by hand, dipping into the warm mixture with a fork. Milk chocolate can be made by adding dried or evaporated milk to the chocolate mixture, but fresh full-cream milk, condensed immediately before mixing, is best. Slab chocolate has a high food value in proportion to its bulk and weight.

Cocoa butter, which has a pleasant smell and does not easily turn rancid, has many other uses, *e.g.* in the manufacture of soaps and pomades.

COCONUT PALM: A MOST USEFUL TREE

The coconut is encased in a skin, consisting of a layer of coarse fibres. This fibrous cover, called coir, is used in making ropes, brushes, and furniture stuffing. The dried white "meat" of the nut, called copra, yields oil, which is used for the making of soap and margarine.

Coconut Palm. From its home in Africa this palm has spread to nearly all tropical coasts and islands. It is known to botanists as *Cocos nucifera.* To produce "nuts" it must be near the sea and in a hot climate. The trunk grows from 50 to 80 feet high. It is slightly curved, and crowned with a tuft of huge, feather-shaped leaves which reach 18 feet in length and have leaflets about a yard long. Branching spikes of flowers produce branches of coconuts—green egg-shaped fruits turning dry and brown and enlarging to nearly the size of Rugby footballs. The coconuts sold in greengrocers' shops have had the skin and fibre removed, and consist of the hard inner lining of the fruit and the enormous hollow seed. One of the three round marks at one end is a soft place where the root could come through. The crisp, white, nutty substance and the "milk" are intended by nature as food for the young plant. A complete coconut is surprisingly light in weight because of the air in its fibrous cover, and many have probably floated long distances over the sea without harm.

Coconut plantations need scarcely any attention after the second year, and begin producing nuts after six years' growth. A dwarf palm called the king coconut has been introduced in some districts. This fruits in the fourth year.

No tree is more useful than the coconut palm. Growers find a use for every part except the root. The most important part is the food in the shell. When dried in the sun, this nut "meat" is called copra. It has been used for human food for hundreds of years; and from it comes coconut oil, which is solid at ordinary temperatures and is used for making soap, margarine, and confectionery. The fibre, or coir, is used in mats, ropes, brushes, and furniture stuffing. The wood of the trunk provides rafters for huts which are thatched with palm leaves. Mats and baskets are made from the leaflets; and brooms, fences, cattle yokes, and furniture from the leaf stalks. The large bud in the crown of the tree may be used as a cabbage, but removing this will kill the tree. Parrots as well as human beings pierce the base of the flower stem to get an intoxicating drink called palm toddy, from which both sugar and vinegar can be obtained.

Cod. The common cod, *Gadus callarias*, and its relatives such as the haddock, hake, whiting, and ling, form one of the most important groups of food fishes in the world (family, *Gadidae*). They are especially plentiful in the North Atlantic and the North Sea. The cod itself is a large, carnivorous fish, sometimes reaching a weight of 100 lb., when it is five feet or so in length. It is a bottom feeder (that is, it feeds near the sea bottom), and it is caught as a rule by trawling, although the old long-line system, whereby a line going to considerable depths carries a number of baited hooks, is still used to some extent.

Almost every part of the cod is valuable. Apart from the flesh and roes as human food, the oil from the liver is of great value in medicine, isinglass is obtained from the air-bladder, and the heads are used to prepare fish meal for cattle food and manure.

In appearance this fish is greenish-grey above

and whiter below; there is a barbel, or fleshy feeler, below the chin. All fish of the cod family lay large numbers of eggs. A full-grown female cod may lay as many as ten million at a single spawning.

Codes and Ciphers. If you look at the letter heading of a big business house which has many dealings with foreign countries, it is quite likely that you will see some such words as "Codes: A.B.C. and Bentley's." That means simply that any correspondent abroad who wants to send a cable or radio message can use either of the two systems named, knowing that his message will be easily decoded into plain English at the other end. There are two main reasons for using codes (which consist, in effect, of artificial "portmanteau" words). One is secrecy. The other is the saving of money; for if, for example, your code word, say "polo," represents: "Please cable at once the lowest price per ton at which you can buy," it is easy to see that you are paying for one word instead of 14. In trades where it is necessary to get quick news from abroad, in journalism, and in military and naval operations, to send in "plain language" would not only be ruinous in cost, but would leave the message wide open to anyone who had the apparatus for listening. Foreign correspondents of newspapers have a special language called "cablese," which omits every "a," "the," "are" and the like, and has special suffixes (*e.g.* "-wards," "-wise") to indicate direction and so forth.

The chief use of codes, then, is to secure economy in length. Ciphers serve the same purpose, but their main purpose is to provide secrecy. They are absolutely essential in warfare, for if messages to and from fighting units were sent "in clear" the enemy would know at once what was about to happen, and plan accordingly. Even as matters stand, each country at war employs large and ingenious staffs of cryptographers (as cipher experts are called) to make a constant study of enemy ciphers and to try to "break them down" (as the expression runs) into plain language.

All ciphers fall under one or the other of two headings—Transposition ciphers and Substitution ciphers. In the first the words of the clear message remain the same, but the order is changed. In other words, the message is "scrambled." In substitution ciphers other letters or figures are substituted for those of the clear message.

A quick glance at any cipher message will at once tell a cipher officer which method has been used. In transposition ciphers the original letters of the clear text must appear somewhere in the cipher message. Therefore, spread about in the message, one will naturally expect to find more of the frequently-used letters like E, T, O, A, and N than of the rarer letters like X, Z, J, or Q. But in substitution ciphers the true frequency of the original letters has been lost, and the letters X or Z may occur as often as, or more often than, E or T.

Examples of Transposition Ciphers

The diagram below shows a letter transposition cipher in which the process of transposing depends on a key-word, MARCH, the letters of which are numbered according to their place in the alphabet, thus:

M	A	R	C	H
4	1	5	2	3

Suppose the message to read: "Now is the time for all good men to come to the aid of the party." Underneath the key numerals write the letters of the text from left to right, thus:

KEY

4	1	5	2	3
N	O	W	I	S
T	H	E	T	I
M	E	F	O	R
A	L	L	G	O
O	D	M	E	N
T	O	C	O	M
E	T	O	T	H
E	A	I	D	O
F	T	H	E	P
A	R	T	Y	J*

Fig. 1 (* is a dummy letter which has been added to complete the rectangle)

Now read the columns of letters downwards (not crosswise), beginning with those under column 1, then carrying on by number from 2 to 5. The cipher message then runs: OHELDOTATRITO GEOTDEYSIRONMHOPJNTMAOTEEFAWEF LMCOIHT.

To decipher this message the first thing necessary is to build up a rectangle of the correct size. To do this, take the number of letters in the message, that is 50, divide by the number of letters in the key, namely 5, and this gives the numbers of letters in each column, namely 10. Under the key word build up a rectangle of 5 squares by 10, as in Fig. 2.

Fig. 2.

M	A	R	C	H
4	1	5	2	3

Fig. 3.

4	1	5	2	3
	O		I	
	H		T	
	E		O	
	L		G	
	D		E	
	O			
	T			
	A			
	T			
	R			

Now write in the letters of the cipher message, *i.e.* OHELDO etc., *vertically*, beginning under column 1, as in Fig. 3, going on to columns 2, 3, 4, and 5, until all the squares in the rectangle have been filled in. This will produce the same result as that given in Fig. 1, and the clear message can now be read horizontally.

Substitution Ciphers

The number of methods by which a clear message can be changed into something else is almost unlimited. For example, one letter may be substituted for another, two letters for two letters, two figures for one letter, three figures for two letters, and common words, and so on. In Africa the beating of drums is a secret method of conveying news, and so is a form of substitution cipher.

Here is a very simple substitution method which has been attributed to Julius Caesar, but is probably much earlier than his day. Take the clear message letter by letter, and for each one substitute the letter which falls an agreed number of places before or after it in the alphabet. Suppose, for example, that it is agreed at sending and receiving ends to take the fifth letter after each letter of the message GOD SAVE THE QUEEN. This would go G+five letters=L; O+five letters=T; and so on. The easiest way to do this is to write the straightforward alphabet, and under it to write the cipher alphabet, beginning with A+5, *i.e.* F, as follows:

ABCDEFGHIJKLMNOPQRSTUVWXYZ
FGHIJKLMNOPQRSTUVWXYZABCDE

To encipher, take the clear letter from the upper alphabet and the cipher letter from the lower, thus:

GOD	SAVE	THE	QUEEN
LTI	XFAJ	YMJ	VZJJS

To *decipher*, the process is reversed; that is, the cipher letter is taken from the lower alphabet and the clear letter is the one above it in the upper alphabet. This form of "sliding alphabet" can be made far more difficult to decipher by sliding the lower alphabet one place to the right after enciphering each letter.

In any given language there is an unvarying law that certain letters, combinations of letters, and even words, occur more frequently than others. Some readers will remember the adventure of Sherlock Holmes called "The Dancing Men," in which day after day there appeared little groups of mannikins, holding flags, with their arms and legs arranged in certain positions. Holmes solved these cipher messages by noting which symbols appeared most frequently, and comparing these with the so-called "frequency table," which has been proved to remain fairly constant over great numbers of messages. The order of most-used letters is here given for the three best-known languages:

English:
ETOANIRSHDLUCMFPGYWBVKQXJZ

French:
ESANTIRULODCMPVFGQBHJXYZK (no W)

German:
ENIRSTUDAHGOLBMFZCWKVPJQXY

Common combinations of two or more letters are:

English:
TH, HE, IN, AN, ON, RE, THE, ION, AND, TION

French:
ES, LE, DE, RE, QUE, ENT, LES, TION

German:
EN, ER, CH, DE, GE, EIN, ICH, DEN, ICHT

This fascinating subject has wide bearings. It is well known, for example, that tramps leave on the walls of houses chalk-marks well understood by other tramps, with meanings such as "Kind," "Good for a meal," "Bad-tempered," and so on. British income tax is also run on a "code"—the lower the code number the less are the allowances and reliefs, and so the greater is the proportion of earnings paid in tax.

Ciphering can be carried out by machines, the clear message being "fed in" at one end, "scrambled" in transmission, and "fed out" in clear again at the receiving end. For obvious reasons, all details of the operation of such machines must remain official secrets. British cipher officers are bound by the Official Secrets Act even when they leave the service.

Readers should turn to the articles on Morse (inventor of the Morse code), Signalling, and Telegraphy.

Coffee. While tea is the most popular household drink in Great Britain, coffee is the chief beverage of Europe. The United States, too, is a very large consumer, and coffee has always remained the traditional drink in the Middle East, where it originated. It contains a stimulant, caffeine, and according to an ancient Arab legend, coffee was discovered in Abyssinia in the 3rd century A.D. by some Christian monks, who observed how their sheep and goats, after browsing on a certain shrub, were wakeful and full of energy at night when they should have been sleeping. The prior picked and ate some of the fruits of the shrub and he, too, felt an unusual sense of exhilaration and wakefulness.

This legend of the discovery of coffee may be fanciful, but certainly Abyssinia and Arabia were the original homes of the plant. No exact date can be given for the beginning of the coffee-drinking habit. It must have grown up gradually, but by the 15th century, pilgrims to Mecca were drinking an infusion of the roasted bean to prevent drowsiness during the long Mahomedan religious services. From Arabia the practice of coffee-drinking passed to Constantinople (now Istanbul) and thence to Venice, and to England, France, and other European countries, mainly through the example of the Turkish ambassadors.

The word "café" has its origin in the coffee-houses that were set up in France in the 17th and 18th centuries. In England the coffee-houses of that period became meeting-places for people of fashion, for politicians, artists, and men of letters; in London they were in part the forerunners of the

clubs, and Lloyd's, the world-famous shipping insurance house, began in this way.

Until the end of the 17th century all coffee came from Arabia. It was shipped from Mocha, the port of the Yemen, and the name Mocha (pron. mō'ka) is still applied to all Arabian coffee as well as to coffee resembling it in colour and taste.

The following century saw the beginnings of the great coffee plantations in other parts of the world. The plant was grown first in southern India and the Dutch East Indies, and later in the West Indies and South and Central America. About 1900, coffee-growing was started in the British colonies in East Africa. To-day most of the world's output comes from South and Central America. Brazil is by far the largest producer, with Colombia second.

The coffee plant belongs to the genus *Coffea* of the family *Rubiceae.* The three most important cultivated species are *Coffea arabica* (Arabian coffee), which is the most widely grown and provides the best coffee; *C. liberica* (Liberian coffee); and *C. robusta.* The plant is an evergreen, and would grow naturally to 15 or 20 feet high, but is pruned to about 6 or 8 feet so that the berries can be easily picked. It is grown in warm, dry climates where the temperature never falls below 55°F.—frost would kill the plant—and at heights between about 1,500 and 6,000 feet. Broadly speaking, the best-flavoured coffee comes from plantations at 3,000 feet and upwards.

A full crop of coffee berries is not obtained until the plant is about six years old. The berries take six to seven months to ripen. Because they do not all ripen at the same time, the harvest extends over a long period; there are usually three pickings in a season. The berry is green at first, then a golden brown, and finally a bright red, not unlike a cherry in colour and size. Inside the berry, surrounded by a yellow pulp, are normally two oval seeds lying with their grooved and flattened faces together. These are the beans from which coffee is prepared. Sometimes there is only one seed, shaped like a pea; this is the so-called "peaberry coffee" which, carefully separated from the other beans, commands a higher price.

After harvesting, the beans are cured by either the "dry" or the "wet" process. Both processes involve the mechanical separation of the beans from the pod and pulp, and the removal of the "parchment" (the outer covering of the bean itself) and of the delicate second covering called the silver skin. Drying and fermentation take place in the sun or artificially in hot air. The result is the raw or green bean, which is then roasted in revolving cylinders to give it the characteristic aroma and flavour of coffee. Coffee roasted to a medium brown colour has the delicate aroma most popular in Great Britain and in the United States—in both countries it is more usually drunk with milk or cream. In Europe, where coffee is usually taken "black" (without milk), a dark roast is preferred, and this increases the strength of the drink.

Before coffee is made the beans must be ground, and the best drink is prepared from those which are freshly ground. It is important, too, to use plenty of coffee. Failure to make a really good cup often arises because people do not use enough. Many experts recommend an earthenware jug for best results. The jug should be warmed before the

WOMEN WINNOWING COFFEE BERRIES

To remove dirt and leaves from the harvested berries, women toss them in sieves. To get rid of any further impurities, the berries are raked through a washing trough, after which process they are spread out in the sun on a drying floor (*See* BRAZIL picture p. 53).

PICKING THE RED BERRIES

The white flowers of the coffee shrub are succeeded by berries, which at first are green in colour. They then turn to a golden brown, and finally a bright red.

coffee is put into it, and the water added must be boiling, not just hot. Ready-made coffee is frequently sold mixed with chicory to make it less expensive; this has a slightly different flavour from that of pure coffee.

Coke. Coal which "no longer smoakes nor stinks" is how coke was first described in the 17th century. The discovery of coke was a necessity at that time. Engines and machines were being invented, and the smelting of iron ore by using charcoal became difficult as Britain's forests dwindled. Coal was found to be unsuitable for use in the furnaces, so it was burned like wood and the resulting caked mass was called coke. Coke is to coal what charcoal is to wood. Like charcoal, coke is mainly composed of carbon (see article.)

In 1708, Abraham Darby, of Coalbrookdale, Shropshire, conceived the idea of treating coal in a closed oven, extracting nearly everything but carbon. The resulting product was a hard, brittle, dark-grey material of semi-metallic appearance, much lighter than coal and with a porous or sponge-like structure. This coke was found to be suitable for use in iron-smelting, burning quickly, almost smokelessly, and with intense heat. The beehive oven (so called from its shape) was used commercially about 1855, but was soon found to be wasteful. Better ovens were invented, which permitted the recovery of the volatile matter (gas and tar) which is driven off when coal is heated at a high temperature out of contact with the air.

To-day coke oven plants are as much concerned with the recovery of by-products as with the manufacture of the coke. These former "waste" products have become increasingly important, notably tar, benzole, sulphur, and ammonia. From these, by further chemical processing, is obtained a wide range of chemical substances used in the manufacture of dyestuffs, fertilisers, plastics, germicides, insecticides, perfumes, and synthetic yarns.

Present-day coke ovens made of silica bricks stand in a battery formation looking like rows of tall thin books, each separated from the other by a flue in which gas is burnt to heat the walls of the ovens. Sometimes as many as 60 stand side by side. An oven usually holds 15 tons of coal, which is heated for about 18 hours at 1,300° C. The coal is fed in through doors in the roof, and the by-products are recovered by pipes. The resulting white-hot mass of coke, weighing two-thirds of its original weight, is pushed out into steel trucks which carry it to the water-cooling tower, where three tons of water cool one ton of coke. Quality is tested regulary by "shatter" tests—the dropping of weighed quantities from a height.

Coals used for coke-making come from a group of ordinary, bright-burning coals called "bituminous," some of which cake easily. "Coking" coals give a strong, hard coke not easily broken up in a blast furnace. They have a low content of volatile matter. The finest coking coals in Great Britain are found in Durham and South Wales. Coke is also produced in immense quantities at gasworks during the manufacture of ordinary gas for heating and lighting. Gas-making coals must have a high volatile content to ensure a high yield of gas when the coal is carbonised, and the resulting coke is soft and inferior to coke-oven coke. It is used for heating furnaces, making producer-gas and water gas, raising steam, and domestic heating.

Colchester, Essex. Probably the oldest town in Britain, Colchester has a recorded history which goes back to the British king Cunobelinus (Cymbeline), who reigned about A.D. 10–43 at Camulodunum, as Colchester was then called. The greater part of the town wall built by the Romans in A.D. 150 still stands, and many relics of their occupation have been found, such as pavements, coins, and pottery.

Colchester stands on the river Colne, about nine miles from the sea. Small ships can reach the Hythe, a mile from the centre of the town. The castle, which dates from about 1080, was built by the Normans partly from Roman material. The chief portion that remains is the keep, the largest in England, the walls of which are 12 feet thick. It is now a museum, and the grounds have been laid out as a public park. The town has remains of an 11th-century monastery and a 12th-century church.

Colchester is famous for its beds of oysters and for its roses. It is an important market town, and its industries include engineering and the manufacture of clothing. The population in 1951 was 57,436.

When the Romans occupied Camulodunum in A.D. 43, the town had been a British stronghold for some time. The British settlement had been by the river, and the Romans built on the hill close by, where the present town stands. Their first settlement was destroyed by Boadicea in 61. The Roman occupation lasted until about 367.

COLCHESTER CASTLE'S NORMAN KEEP

Colchester Castle was built about 1080, and much material from the old Roman city of Camulodunum was used in its construction. The keep, which is the largest in the United Kingdom, measures 155 feet by 113 feet, and the walls are 12 feet or more in thickness. In the Civil War it held out nearly three months for King Charles I.

The Saxons followed the Romans, and in King Alfred's reign (871–901) Colchester suffered greatly at the hands of the Danes. In the reign of King John a French force occupied it in 1215 on behalf of the English barons, but was driven out after a siege. Colchester sided with Charles I in the Civil War, and after an eleven-week siege by the Parliamentarians fell on August 28, 1648.

Excavations are still proceeding over the area covered by the ancient town Camulodunum. From time to time farmers turn up relics as they plough, but knowledgeable digging gives the best results.

Coleridge, SAMUEL TAYLOR (1772–1834). "Stop, you young thief!" An angry man in a crowded London street was storming at a pale, innocent-looking little boy, whose bare head, long blue coat, and yellow stockings marked him as a pupil of Christ's Hospital, the famous school now near Horsham, in Sussex, but then situated in Newgate Street, London. The boy's outstretched arms fell and his eyes flashed with a strange light. "Ah," he sighed, as if awakened out of a dream. "I thought I was Leander swimming the Hellespont. I did not mean to touch your pocket, sir!"

The bluecoat boy was Samuel Taylor Coleridge, and the result of this strange incident was that the old gentleman bought for him a subscription to a library. So the dreamer went on reading, and acting what he had read, and living in his own world of strange and beautiful fancies. When in Devon—before his father died and he was sent to school in London—he used to roam about the fields near his native village of Ottery St. Mary and slash off the tops of weeds as he went, imagining himself St. George slaying the Dragon. At the age of five he had already read the Bible, the *Arabian Nights*, and *Robinson Crusoe*.

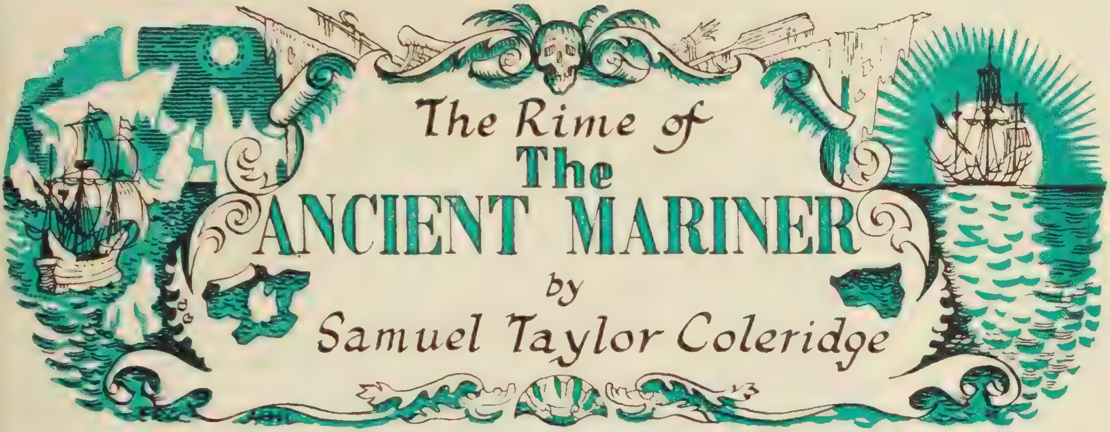
At Christ's Hospital he was a brilliant student, and at Cambridge University also. But he got into debt, ran away to London, and enlisted in the army under an assumed name. After a few months his relatives secured his discharge, and he returned to the university, but he left it without a degree.

Coleridge's natural disposition to day-dreaming, increased by the use of opium, which he started taking to relieve the pains of neuralgia, was the weakness that wrecked his life and made his work a mere fragment of what it might have been. Indeed, had it not been for the help of friends, he could not have got along at all. On the other hand, it is to this same imaginative power that we owe his brilliant dream-poems—*The Rime of the Ancient Mariner*, *Christabel*, and *Kubla Khan*.

In spite of his frailties, the personal influence of Coleridge was very great, and in his last years he was visited by many noted men who listened spell-bound to his marvellous talk. Among his great friends were Charles Lamb and William Wordsworth. With Wordsworth he had planned a new form of poetry, exemplified in their *Lyrical Ballads* (1798), an important literary milestone.

To-day it is for the few great poems written in his earlier years that Coleridge is chiefly remembered. Of his poetry it has been well said, "All that he did excellently might be bound up in twenty pages, but it should be bound in pure gold." Though we think of Coleridge chiefly as a poet, he wrote more prose than poetry. His *Biographia Literaria* (1817) gives a profound analysis of the nature of poetry and the principles of criticism. His *Lectures on Shakespeare* (published in 1849 after his death) show that he was one of the greatest of Shakespearean critics. *Aids to Reflection* (1825) is the most famous of his numerous philosophical and religious works.

In recent years students have found great attraction in Coleridge's speculations and several new editions of his philosophical lectures have been issued. Moreover a more detailed study has been made of his many letters, in which his problems, hopes, fears, and ambitions appear in a more intimate form than in his literary publications.



THIS well-known poem by Samuel Taylor Coleridge, first printed in 1798, is too long to be reproduced here in full, but the verses which follow should convey something of its compelling narrative power, its vivid and sometimes horrifying imagery, and its haunting beauty.

The Ancient Mariner is a man who has undergone terrible experiences both natural and supernatural, and is impelled to wander over the earth relating them to any individual destined to profit by hearing them.

" I pass, like night, from land to land ;
I have strange power of speech ;
That moment that his face I see,
I know the man that must hear me :
To him my tale I teach."

One such man, encountered by chance, is a guest on his way to a wedding—one of three. The other two pass on their way, but this one is compelled, against his own urgent desire, to stand and listen to the Mariner.

" He holds him with his glittering eye—
The Wedding-Guest stood still,
And listens like a three years' child :
The Mariner hath his will.

And this was his story :

" The ship was cheer'd, the harbour clear'd,
Merrily did we drop
Below the kirk, below the hill,
Below the lighthouse top.

" The Sun came up upon the left,
Out of the sea came he !
And he shone bright, and on the right
Went down into the sea.

. . . . . .

" And now the Storm-blast came, and he
Was tyrannous and strong ;
He struck with his o'ertaking wings,
And chased us south along.

" With sloping masts and dipping prow,
As who pursued with yell and blow
Still treads the shadow of his foe,
And forward bends his head,
The ship drove fast, loud roar'd the blast,
And southward aye we fled.

" And now there came both mist and snow,
And it grew wondrous cold :
And ice, mast-high, came floating by,
As green as emerald.

. . . . . .

" The ice was here, the ice was there,
The ice was all around :
It crack'd and growl'd, and roar'd and howl'd
Like noises in a swound !

" At length did cross an Albatross,
Thorough the fog it came ;
As it had been a Christian soul,
We hail'd it in God's name.

" It ate the food it ne'er had eat,
And round and round it flew.
The ice did split with a thunder-fit ;
The helmsman steer'd us through !

" And a good south wind sprung up behind ;
The Albatross did follow,
And every day, for food or play,
Came to the mariners' hollo !

" In mist or cloud, on mast or shroud,
It perched for vespers nine ;
Whiles all the night, through fog-smoke white,
Glimmer'd the white moonshine."

" God save thee, ancient Mariner,
From the fiends that plague thee thus !—
Why look'st thou so ? "—" With my crossbow
I shot the Albatross.

. . . . . .

" And I had done a hellish thing,
And it would work 'em woe :
For all averr'd I had kill'd the bird
That made the breeze to blow.
Ah wretch ! said they, the bird to slay,
That made the breeze to blow !

. . . . . .

" Down dropt the breeze, the sails dropt down
'Twas sad as sad could be ;
And we did speak only to break
The silence of the sea !

" All in a hot and copper sky,
The bloody Sun, at noon,
Right up above the mast did stand,
No bigger than the Moon.

" Day after day, day after day
We stuck, nor breath nor motion ;
As idle as a painted ship
Upon a painted ocean.

" Water, water, everywhere,
And all the boards did shrink ;
Water, water, everywhere
Nor any drop to drink.

" The very deep did rot : O Christ !
That ever this should be !
Yea, slimy things did crawl with legs
Upon the slimy sea.

" About, about, in reel and rout
The death-fires danced at night ;
The water, like a witch's oils,
Burnt green, and blue, and white.

. . . . . .

" And every tongue, through utter drought,
Was wither'd at the root ;
We could not speak, no more than if
We had been choked with soot.

" Ah ! well a-day ! what evil looks
Had I from old and young !
Instead of the cross, the Albatross
About my neck was hung."

Then the Mariner describes the passing of a strange, spectral ship in which, by the lurid light of the sunset, two ghostly figures were seen throwing dice ; and how, as this ship sailed by and the moon rose, all the Mariner's companions dropped down dead.

" One after one, by the star-dogg'd Moon,
Too quick for groan or sigh,
Each turn'd his face with a ghastly pang,
And cursed me with his eye.

" Four times fifty living men
(And I heard nor sigh nor groan),
With heavy thump, a lifeless lump,
They dropp'd down one by one.

. . . . . .

" Alone, alone, all, all alone
Alone on a wide, wide sea !
And never a saint took pity on
My soul in agony.

" The many men, so beautiful !
And they all dead did lie :
And a thousand thousand slimy things
Lived on ; and so did I.

" I look'd upon the rotting sea,
And drew my eyes away ;
I look'd upon the rotting deck,
And there the dead men lay.

" I look'd to heaven, and tried to pray ;
But or ever a prayer had gusht,
A wicked whisper came, and made
My heart as dry as dust.

" I closed my lids, and kept them close,
And the balls like pulses beat ;
But the sky and the sea, and the sea and the sky
Lay like a load on my weary eye,
And the dead were at my feet.

" An orphan's curse would drag to hell
A spirit from on high ;
But oh ! more horrible than that
Is the curse in a dead man's eye !
Seven days, seven nights, I saw that curse.
And yet I could not die.

. . . . . .

" Beyond the shadow of the ship,
I watch'd the water-snakes :
They moved in tracks of shining white,
And when they rear'd, the elfish light
Fell off in hoary flakes.

" Within the shadow of the ship
I watch'd their rich attire :
Blue, glossy green, and velvet black,
They coil'd and swam ; and every track
Was a flash of golden fire.

" O happy living things ! no tongue
Their beauty might declare :
A spring of love gush'd from my heart,
And I bless'd them unaware :
Sure my kind saint took pity on me,
And I bless'd them unaware.

" The selfsame moment I could pray ;
And from my neck so free
The Albatross fell off, and sank
Like lead into the sea.

" O sleep ! it is a gentle thing,
Beloved from pole to pole !
To Mary Queen the praise be given !
She sent the gentle sleep from Heaven,
That slid into my soul.

" The silly buckets on the deck,
That had so long remain'd,
I dreamt that they were fill'd with dew ;
And when I awoke, it rain'd.

. . . . . .

" And soon I heard a roaring wind :
It did not come anear ;
But with its sound it shook the sails,
That were so thin and sere.

. . . . . .

" The loud wind never reach'd the ship,
Yet now the ship moved on !
Beneath the lightning and the Moon
The dead men gave a groan.

" They groan'd, they stirr'd, they all uprose,
Nor spake, nor moved their eyes :
It had been strange, even in a dream,
To have seen those dead men rise.

" The helmsman steer'd, the ship moved on ;
Yet never a breeze up-blew ;
The mariners all 'gan work the ropes,
Where they were wont to do ;
They raised their limbs like lifeless tools—
We were a ghastly crew.

But the Mariner soon found that these beings were not the ghosts of his former companions, but " a troop of spirits blest."

" For when it dawn'd—they dropp'd their arms,
And cluster'd round the mast ;
Sweet sounds rose slowly through their mouths,
And from their bodies pass'd.

Amid other wondrous visions and experiences, the Mariner was borne homewards to his own country.

" Oh dream of joy ! is this indeed
The lighthouse top I see ?
Is this the hill ? is this the kirk ?
Is this mine own countree ?

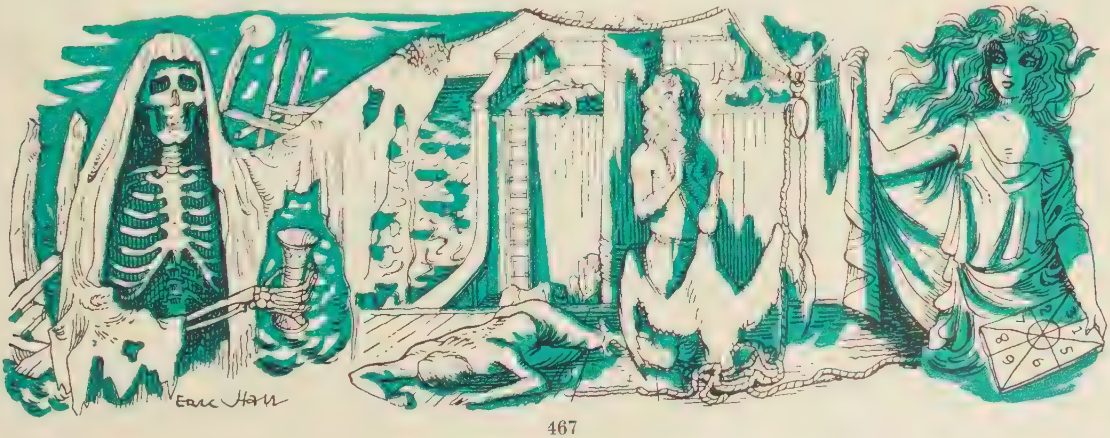
" We drifted o'er the harbour-bar,
And I with sobs did pray—
O let me be awake, my God !
Or let me sleep alway.

" The harbour-bay was clear as glass,
So smoothly it was strewn !
And on the bay the moonlight lay,
And the shadow of the Moon.

But as the Pilot's skiff came out to meet the ship a loud and dreadful sound split the night, and the ship went down and all with it, save the Mariner. His story is now ended, and he parts from the Wedding-Guest with these words :

" Farewell, farewell ! but this I tell
To thee, thou Wedding-Guest !
He prayeth well, who loveth well
Both man and bird and beast.

" He prayeth best, who loveth best
All things both great and small ;
For the dear God who loveth us,
He made and loveth all."



From a drawing by François Clouet

ADMIRAL COLIGNY

Gaspard de Coligny became the active leader of the Protestant party in France about 1557. He was appointed Admiral in 1552, but never held a naval command. He was murdered in the massacre of St. Bartholomew.

Coligny, GASPARD DE (1519–72). Born of a noble family at Châtillon-sur-Loing, in France, Coligny (pron. kōlē′nyē) from his youth had a brilliant military career, and in 1552 he also had conferred upon him the title of admiral, though he never commanded at sea. About 1557 he became a Huguenot (French Protestant). After King Henry II of France had been killed in a tournament in 1559, Coligny became the active leader of the Huguenot party, of which the Prince of Condé was merely the figure-head. Despite his efforts to obtain a peaceful settlement of the religious troubles, civil war broke out, and after Condé had been assassinated in 1569, Coligny was left in sole command of the Protestant armies, nominally under Henry IV of Navarre. By his skill Coligny maintained the contest until 1570, when he brought about a truce and returned to the court.

Catherine de' Medici, the queen mother, saw in the friendship between Coligny and her son Charles IX a menace to her ambitions. On August 22, 1572, Coligny was wounded by an assassin, hired by Catherine. Catherine then worked upon the fears and prejudices of the young king until he cried: "If you must kill Coligny, then let all the Huguenots in France be killed, so none may be left to reproach me."

Catherine asked nothing more. Coligny was among the first to die in a general massacre of the Huguenots that she organized on St. Bartholomew's Day, August 24, 1572. (*See* HUGUENOTS.) His daughter Louise married William the Silent.

Collecting. In the days before the Second World War, when paper and printing were much cheaper than they now are, a cigarette-smoker was liable to be approached by a grubby urchin with the inquiry: "Have you got any cigarette-cards, mister?" Cigarette-cards were to children of an earlier generation often the introduction to the fascinating business of collecting. Called "stiffeners" by the tobacco trade, because their original purpose was to provide a stiff backing for cigarettes sold in limp paper packets, they were amusing and instructive things to have. Usually issued in sets of 50, they had a picture on the front and a cleverly-written 50 or 60 words of explanation on the back. The pictures (usually in colour) might cover such topics as "Interesting Buildings," "Coats of Arms," "Billiards," "Wrestling,"

COLLECTION OF OLD STREET LAMPS

An expert on lamp-post design possesses a strange collection of street lamps. The tall silvery one came from Kensington and dates from 1905, when street-lamps were designed to suit a particular district. Americans sometimes buy such lamps.

"Characters from Dickens," and so on.

Building up the set by asking for cards from smokers, or by swapping duplicates with other boys (or girls), was a thrilling business. That thrill, costing nothing, is the same as the excitement of a rich collector who has paid £20,000 for a painting by John Constable, or tracked down an early printed book by Caxton, or found a beautiful mantelpiece carved by the great Grinling Gibbons.

It is natural and pleasant to collect things, and most boys and girls in civilized countries turn to the sport at an early age. It may begin with seashells, or moths and butterflies, wild flowers and plants, birds' eggs, or postage stamps—even match-box tops or the labels from boxes of cheese. Stamp-collecting (which has its own article, STAMPS, in this book) is enormously popular as a hobby especially in the English-speaking countries, and there are many journals devoted to it and books written about it. Moreover, for many people it does not lose its attraction with advancing years, and one of the finest collections in the world was built up by the British kings George V and George VI.

UNUSUAL COLLECTION OF POLICE BADGES

Forced to abandon her career owing to ill-health, this ex-policewoman made the police forces of the world her hobby. In two years she collected more than 1,000 police badges and insignia from both foreign and British forces, as well as a number of helmets, caps, truncheons and even handcuffs.

For the collection of butterflies and moths (see article) certain special skills are necessary. The would-be collector must first learn how to distinguish clearly a butterfly from a moth; he must learn to identify the various kinds. Then he must catch the insects without mangling them, and then learn how to "set" the delicate wings on a setting board. Simple appliances are needed: a butterfly net, a killing-bottle (made up by a chemist), setting boards, special pins, and storage boxes (preferably with a sheet of cork at the bottom, to take pins easily). The setting board has a long slot down the middle, into which the insect's body falls while the wings are carefully flattened over the sides by pinning down slips of tracing-paper over them.

The making of a herbarium, or collection of dried plants, is also a delightful and instructive pursuit. Surprisingly few people know any but the commonest plants and flowers; but the boy or girl who is making a herbarium doubles the interest of every country walk by being constantly on the lookout for new (and possibly rare) specimens. In order to show any desired plant to advantage, you need one or two good flowering stems and a perfect leaf stem. When you get back home with these, spread them out flat between sheets of blotting-paper and leave a very heavy book on top in order to press and dry them. When they are dried, attach the specimens to uniform-sized cards with a touch of glue here and there, press the cards again after the glue is dry, neatly label each specimen, and store flat in a drawer in good order.

Early in the present century it was considered the normal thing for boys to rob birds' nests and form a collection of birds' eggs. But, while it is desirable for educational purposes to have such collections in natural history museums, the practice of making private collections of this type is now rightly frowned upon by bird-lovers.

Wider fields of collecting have been, and are, covered by grown-up connoisseurs (*i.e.* men of fine and cultivated taste, good judges of the merits of a work of art). Though such people have worked chiefly for the adornment of their own palaces or fine houses, they have been, indirectly, of great service to the ordinary man. Many of them have bequeathed their collections to the public at death. All of them have looked after their treasures with loving care, and to them humanity owes the preservation of many beautiful things which would otherwise have become scattered and lost, or might have been destroyed, by time, weather, misuse, or the stress of war.

In the great days of the Renaissance (see article) many of the popes, many Italian princely families like the Medici and the Borgias, were passionately

ARDENT ADMIRERS OF MATCH-BOXES

Collectors of match-box labels are called phillumenists, and they are just as absorbed in their hobby as are the cartophilists, the collectors of cigarette cards. These three enthusiasts are examining the rather florid decorative work on some Japanese match-box labels with the aid of a magnifying glass.

National Gallery, London. Notable modern collectors include the Americans John Pierpont Morgan (1837–1913), Henry E. Huntington (1850-1927), and Andrew Mellon (1855–1937), and the Armenian, Calouste Gulbenkian (1869–1955). Morgan's priceless library of early printed books, illuminated manuscripts, and special press books was made over to public use by his son of the same name (1867–1943). The Huntington library and art collection, at San Marino, near Pasadena, California, has the best collection of early printed books in the United States, and a fine assemblage of paintings of the English school, including the celebrated "Blue Boy" of Gainsborough. Mellon, who made a great fortune, spent much of it on founding the National Gallery of Art at Washington, D.C.

But it is not necessary to be wildly rich to be a collector. Admirable etchings, woodcuts, and other prints may be picked up for a few guineas. The bookshops and antique shops still hold treasure-bargains for the buyer who knows "what is what." Taste is the thing, and love of beauty, and added to all this, the excitement of the chase.

enthusiastic collectors of all kinds of art. Great artists like Cellini, Raphael, and Michelangelo owed their very livelihoods to such connoisseurs.

In England the royal family has numbered many fine collectors in its ranks. Henry VIII was prominent among them; so were both Charles I and Charles II. Queen Victoria's consort, Prince Albert, though he lived in an age of bad taste, was one of the earliest prominent men to take an interest in early Italian paintings.

Wealthy noblemen, merchants, and others have also been outstanding in this field. Lord Arundel (1586–1646) was an early starter; Elias Ashmole (1617–92), the archaeologist, inherited objects from North America, the Congo, Polynesia and elsewhere collected by one John Tradescant, and bequeathed them to Oxford University to form the Ashmolean Museum. John Julius Angerstein (1735–1823), a London merchant, was an indefatigable collector of pictures, and 38 of these formed the nucleus of the

MONEY-BOXES OF ALL SHAPES AND SIZES

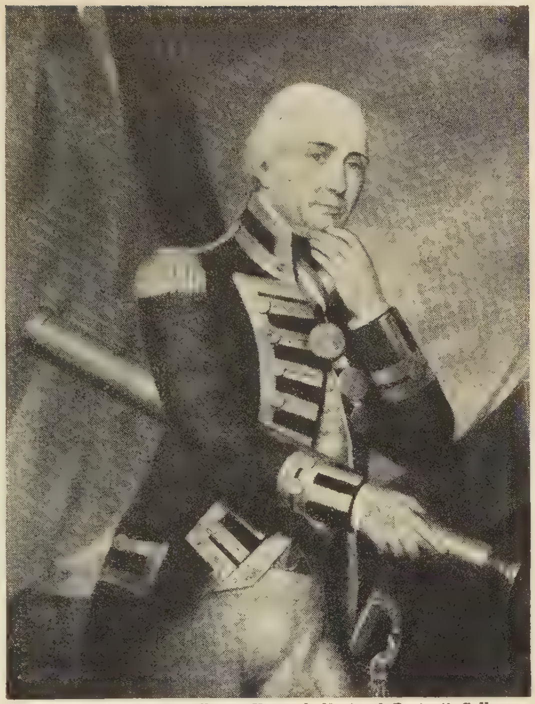
During a visit to Sweden the owner of this remarkable collection was so impressed by the unusual specimens he saw there that he decided to start collecting. All the money-boxes seen in the picture are either very old or of most unusual design. Miniature pigs and houses are used as money-boxes by the children of many countries.

Collingwood, Cuthbert, Lord (1750–1810). In St. Paul's Cathedral, London, not far from the tomb of Nelson, victor of Trafalgar, is that of his second-in-command, Collingwood.

Born at Newcastle-upon-Tyne in 1750, Collingwood volunteered for the Navy at the age of 11, and from then onwards most of his life was spent at sea. In 1775 he fought in the battle of Bunker's Hill, early in the War of American Independence, as one of a company of sailors attached to the British army. He was associated with Nelson off the West Indies during 1783–86, commanded the *Barfleur* in the "Glorious First of June," 1794, and the *Excellent* in the battle of Cape St. Vincent, February 14, 1797.

At Trafalgar, on October 21, 1805, Nelson in the *Victory* led one column of the British fleet, and Collingwood, in the *Royal Sovereign*, a second column, against a combined force of French and Spanish ships. "See how the noble fellow Collingwood takes his ship into action," cried Nelson. Collingwood was the first to engage the enemy, and at one time he was surrounded by four enemy ships. After Nelson was mortally wounded Collingwood took over the command of the British fleet. As a reward for his share in the great victory he was given a peerage and a pension of £2,000 a year. Then he was appointed commander-in-chief in the Mediterranean and continued to serve in this capacity until his death at sea on March 7, 1810.

A bold fighter, he had never the initiative of Nelson. His period as commander-in-chief in the Mediterranean showed he had not understood Nelson's tactics, for in 1808 he let slip a French fleet between Sicily and North Africa. A stern disciplinarian, Collingwood gave far too much of his time and energy to desk work, and hastened his death thereby.



Portrait by Henry Howard, National Portrait Gallery

ADMIRAL LORD COLLINGWOOD

At the battle of Trafalgar, Vice-Admiral Collingwood was Nelson's second-in-command, and in the *Royal Sovereign* led the second line of the fleet. After Nelson was wounded at the moment of victory the command fell to Collingwood, and he then carried out the original plan.

Colloids. In a certain well-known type of examination question, candidates are given a list of things and asked to state what they have in common. Suppose the various items were fog, the froth on a glass of beer, butter, ruby glass, dust, clay, caramel, and a cellulose lacquer, what would the answer be? Is there, in fact, a true answer? Well, there is, but as might be expected, it is not a simple one.

All the above items are examples of colloids, so called from the Greek *kolla*, meaning glue, since the first substances to be recognized as such were all glue-like: for example, gelatin, albumen, and gums. The wide variety of the list springs from the fact that the term "colloid" is not restricted to a particular type of substance, but is used rather to define matter in a certain state, the "colloidal state." Almost any substance will behave like a colloid under certain conditions. What, then, are the distinguishing features of this fourth state of matter, not solid, not liquid, and not gaseous?

To answer this, it is necessary to go back to 1861 when Thomas Graham, an English chemist, was carrying out work on the diffusion of gases and liquids. He noticed that some compounds in solution, such as salts and sugar, passed easily through a parchment membrane, but that others, like gums and starch, did so very slowly or not at all. Graham called the first class of substances "crystalloids" and the second class "colloids," but he realized that the distinction was not rigid, since many crystalline substances—for example, sulphur and graphite—could be obtained in a colloidal condition. Other workers realized that the reason why Graham's colloids would not pass through the membrane was that the particles in solution were too large, although not large enough to be seen by the naked eye. In a true solution, such as one of salt, the salt particles are of molecular size. On the other hand, in an emulsion like salad cream, the particles of liquid fat in water are big enough to be seen under a microscope. Colloidal systems fall between these extremes, but there are no sharp dividing lines among the different states. Colloidal particles can be detected by means of an ultra-microscope, under which they appear as bright points of light against a dark background. A similar effect is seen when a shaft of sunlight enters a darkened room and reveals the specks of dust which float about. Colloidal particles are usually less than 2×10^{-5} cm. across (about one hundredth of the thickness of very thin paper) and more than 5×10^{-7} cm. across. They consist of groups of smaller particles such as molecules and ions, but some single molecules, for example, those of proteins, starch, rubber, and plastics, are large enough for solutions of these materials to show colloidal properties.

As the original list indicates, there are many types of colloidal system, nearly all of which play a vital part in everyday life. Very few of them can be regarded as pure chemical substances. The majority consist of particles or drops of one

COLOGNE : ST. PETER'S CATHEDRAL

Damaged during the Second World War (1939–45), Cologne's cathedral was re-opened to the public in 1956 after completion of repairs to the nave. It was begun in 1248, but the twin towers, 515 feet high, were not completed until the 19th century. It is the largest Gothic cathedral in northern Europe.

material distributed throughout the bulk of a second material. For example, a smoke or dust is composed of solid particles dispersed in a gas; an emulsion such as milk, of small drops of one liquid in another; and a paste such as putty, of solid particles in a liquid. The particles never rise to the top as globules of cream do in fresh milk, or fall to the bottom as freshly precipitated salts do in water. If milk is homogenised, however, the cream particles are broken up to colloidal sizes, and they can then be supported by the continual bombardment of the other particles in solution. Similarly, in a fog, the water particles are small enough to be kept up by collisions with air molecules, but in a cloud they become large enough to fall as rain.

The variety and complexity of colloidal systems, the lack of definite characteristics, and the difficulty in obtaining consistent results have meant that a really scientific study of such systems has only recently been made. The development of the electron microscope, which allows the size and shape of colloidal particles to be determined, and the preparation of materials like synthetic rubber which resemble naturally-occurring colloids, have helped to a better understanding of the behaviour of colloidal systems and how they can be used to the best advantage.

Oil and grease are often difficult to remove from fabrics. Solutions of soap or detergents displace the oil film from the fabric surface, and the oil collects in drops which are then shaken off mechanically. The drops rise to the surface to form a layer, and if the fabrics were removed through this, they would become dirty again. The oil is therefore converted into an emulsion by stirring, which coagulates the oil drops to colloidal size. These larger drops will not attach themselves to the fibre as easily as a thin film.

The plastic properties of clay depend partly on the colloidal size of the particles. They remain easily suspended in water, and are the cause of turbidity in muddy water; on settling, they form a sediment which is sticky enough to be cast in a mould. Clay particles are negatively charged in solution, and if this charge is neutralised by an electrolyte (*see* ELECTROLYSIS), they coagulate and settle out. Clay carried down by rivers is coagulated on mixing with sea water, and is deposited to form harbour bars, mudbanks, and deltas.

The extraction of metals from their ores by froth flotation depends upon colloidal properties. The earliest recorded application was the preparation of the Golden Fleece by dipping a sheep's fleece into a colloidal suspension of gold in a stream. The gold particles were oiled by the natural greases from the wool and stuck to it. Nowadays ores are concentrated by suspension of the finely crushed ore in water containing certain chemicals, and the blowing of air through the solution. The colloidal particles of ore stick to the air bubbles and rise to the surface to form a froth. This is skimmed off, while unwanted non-metallic sandy material sinks to the bottom.

Cologne, GERMANY. The great city and river port of Cologne lies on the Rhine in the West German province of North-Rhine-Westphalia. In 1950 it had a population of 629,200. Originally founded as a settlement for army veterans by the mother of the Roman emperor Nero, Agrippina, who gave it its first city charter in A.D. 51, it was first called Colonia Agrippina, "Agrippina's Colony." This was shortened to Colonia, and the modern German name is Köln, (Cologne being the French version).

As it lay at the crossing of important trade routes, the city soon grew prosperous. It had a Christian community and its own bishop as early as A.D. 313. When Roman rule weakened, the town fell to the Franks. In A.D. 785 Charlemagne raised it to an archbishopric. In the Middle

Ages, under the rule of its merchants, whose membership of the Hanseatic League brought it the riches of Europe, Cologne flourished greatly.

In 1164 Frederick Barbarossa transferred from Milan to Cologne the relics of the Magi—the three kings, or wise men, who came to worship Christ at His Nativity. The cathedral, where they were placed, soon proved too small to hold the many pilgrims who came to see them. In 1248 a new one was started, which became the largest Gothic cathedral in northern Europe, though it was not completed until 1880. The relics of the Magi, enclosed in a gold- and silver-covered case, can still be seen there, together with many fine examples of medieval stained glass, sculpture, and painting. In 1941 a large Roman mosaic floor representing Dionysus and a satyr was discovered just by the south wall.

Many other churches and monuments, a great city wall, and, in the 15th century, a guildhall and a town hall were built. One of the churches, St. Ursula's, is dedicated to the saint who, according to legend, was martyred in Cologne in the 3rd century together with eleven thousand virgins (probably a mistranslation !). A university, founded in 1388, attracted some of the greatest teachers of Europe. Cologne was the centre of German Catholicism. The guildhall became the meeting place of the diets of the Holy Roman Empire, and from the 11th to the 16th centuries Cologne's archbishops claimed the right to crown German kings.

The Thirty Years' War lessened the city's prosperity. During 1797–1815 it was incorporated with France, and the university was closed. It was not until the railways came, and dredging of the Rhine allowed ships to dock there all year round, that Cologne began to thrive again. In 1881 the medieval wall was knocked down and converted into what is now the main boulevard, the Ring. In 1919 the university was re-established and a modern town grew up round the medieval centre.

Though severely damaged by bombing during the Second World War, Cologne has fully recovered. It is a key point in the West German railway system. Its metal and chemical works, soft-coal mines, and power stations are in full production. The famous "Eau de Cologne," a perfume invented by an Italian immigrant, Giovanni Maria Farina, in 1760, and still sold by the same house, is exported all over the world. The annual carnival, held just before Lent, *Rosenmontag* or "Mad Monday," attracts crowds from all over Germany. Many new buildings in ultra-modern style have gone up. Cologne is once again a rich city.

Colombia. This equatorial, mountainous South American republic, named in honour of Christopher Columbus, who explored part of its Atlantic coast in 1502, is situated on both the Atlantic and the Pacific oceans, with about 1,000 miles of coast north of the Isthmus of Panama and 800 to the south.

On the north, Colombia faces that part of the Atlantic Ocean called the Caribbean Sea, the Spanish Main of the buccaneers and pirates. To the west, separating the Caribbean Sea from the Pacific Ocean, lies the republic of Panama. On the east Colombia's neighbour is Venezuela, and on the south it adjoins Ecuador, Peru, and Brazil. The republic's area is about 440,000 square miles.

Despite its tropical situation Colombia has a remarkably varied climate. The traveller climbing from the coast to the lofty mountains and table-lands of the Andes passes from the torrid plains of the Magdalena river, where the stones are often too hot to touch, to the uplands fringed by mountain peaks clad in perpetual snow. Crossing regions where the climate is that of spring all the year round, the higher plateaux and mountain slopes are reached, and there heavy mists, piercing winds, and treacherous swamps make travel almost impossible at some seasons of the year, though these districts lie on the main routes between eastern and western Colombia.

The mountainous area, comprising about two-fifths of the whole country, runs nearly north and south in three great ranges: the Cordillera Occidental, or western chain, the Cordillera Central, and the Cordillera Oriental, or eastern chain, enclosing fertile river valleys and uplands of great extent. The vast plains, or *llanos*, lie east and south of the mountains, part being open pasture watered by streams which flow into

OPERA HOUSE AND CATHEDRAL IN COLOGNE

The old opera house in Cologne was destroyed in 1943, and the new one (foreground) opened in 1957. The stage is deeper than the auditorium, which seats some 1,400. Seven hundred years divide the Gothic Cathedral in the background from the stark, "functional" architecture of the new building.

the Orinoco, and part covered with immense unexplored forests, drained by the tributaries of the river Amazon.

The rivers, which run between the great mountain ranges, afford the chief means of communication. The railways are chiefly short isolated lines which run inland from coast ports or connect important inland centres with the Magdalena river. This river, which flows between the eastern and central ranges to the Caribbean, is the main natural highway of Colombia, and is navigable, with one break, for more than 900 miles. Its main tributary is the Cauca. On the Pacific side the one important river is the San Juan, which has, with its tributaries, about 300 miles of navigable channel. Of the Amazon river system, the most important tributaries in Colombia are the Caqueta (Yapura) and the Putumayo. There are air services between the principal cities and to other South American countries and the United States.

RAFTS OF BAMBOO ON A COLOMBIAN RIVER

The rivers of Colombia afford the chief means of communication, as in the whole country there are only some 2,000 miles of railway. The plains of the east and south are covered with forests, which yield rubber, bamboo, indigo, logwood, sarsaparilla, cinchona (a source of quinine), and dye woods.

Of the population, estimated in 1956 to be nearly 13,000,000, about 30 per cent. are of European (chiefly Spanish) descent, 7 per cent. are Indians, 5 per cent. Negroes, and the rest are of mixed descent. The national language is Spanish, and the religion Roman Catholic. About half the population cannot read or write. Most of the people live in the plateaux rather than in the unhealthy coast regions. Many natives of the mountains are still untouched by civilization.

COLOMBIA: REPUBLIC OF THE ANDES

At the extreme north-west of the South American continent, Colombia has coastlines washed by both the Pacific and the Caribbean. It has rich resources.

Colombia is rich in minerals, but the difficulties of transport prevent development of these and other resources. Gold, silver, manganese, mercury, platinum, and oil are found. Oil ranks next to coffee in importance as an export. The forests contain the rubber tree, ivory palm, bamboo, aloe, cinchona (a source of quinine), fustic or dye wood, indigo, logwood, sarsaparilla, and tolu balsam, which is used as a medicine in cases of bronchitis. On the higher levels the crops of the temperate zone are grown; on the coast, bananas and other tropical fruits, the cacao tree (from the beans of which cocoa and chocolate are made), coffee, tobacco, cotton, sugar-cane, and rice. On the plains great herds of cattle are pastured. The wild parts of Colombia are noted for the number and variety of their animals. In the forests are found the jaguar and puma, many species of monkey, two kinds of bear, the tapir, the opossum, the sloth, and the armadillo. In the rivers are alligators, turtles, and fish. Among the reptiles are the boa-constrictor, the rattlesnake, the coral snake and the deadly fer de lance. Bird life includes the toucan, and many species of bright-hued parrots and macaws.

Bogotá, the capital, although situated only a short distance north of the Equator, has a cool, pleasant climate, for it lies 8,600 feet above the sea on a fertile table-land surrounded by the snow-capped peaks of the Andes. Because of

frequent earthquakes the private houses are rarely more than one storey high. With about 650,000 inhabitants, Bogotá is, as far as its wealth permits, a centre of culture. It has a university, founded in 1572, an academy of fine arts, a fine public library, a national observatory, a natural history museum, and a large botanical garden.

The country was conquered and colonised by Spain in the 16th century. The colony was named New Granada. Revolution against Spanish misrule began in 1810, and in 1819 Simon Bolivar (see article) formed the republic of Colombia, including what are now Venezuela and Panama. Soon after, the province of Quito (Ecuador) was added. But the republic broke up in 1830, Ecuador and Venezuela becoming independent republics. Colombia was then reconstructed as the republic of New Granada, and took its present name in 1886. When the Colombian government refused to ratify a treaty that leased to the United States a strip of land through Panama where the canal was to be built, Panama seceded from Colombia in 1903, after a revolt supported by the United States. Compensation was not paid by the United States to Colombia until 1922.

BOGOTÁ, CAPITAL OF COLOMBIA

Situated at an altitude of 8,600 feet on a fertile table-land surrounded by peaks of the Andes, Bogotá has a number of many-storeyed office buildings and blocks of flats. It has all the amenities of a modern capital city.

Colombo. Ships on the long voyage from Europe to the Far East and Australia call at Colombo, the capital of Ceylon (see article and map). Here is one of the largest artificial harbours in the world, covering an area of over 640 acres. The town is important both as a naval station and as a commercial port.

On the west coast of the island, Colombo has fine administrative buildings, and is a popular residential centre. The business quarter lies at the southern end of the harbour, where the government buildings are situated. Farther on is the lake and beyond it Victoria Park, which contains the Colombo Museum and is the centre of the residential quarter. This is small, and some half a mile out of it the visitor comes to farm-land and open country, which is quickly followed by jungle.

COLOMBO, CHIEF PORT AND CAPITAL OF CEYLON

Situated on the west coast of Ceylon, Colombo has one of the largest artificial anchorages in the world, with an area of more than 640 acres. The principal exports are tea, rubber, coconut oil, and copra. The building seen in this picture is the Customs House. Rickshaws and bullock-carts (see the foreground) mix with modern cars in this city.

Between the lake just mentioned and the sea is a narrow isthmus, called Galle Face, where there are promenades and recreation grounds. The water supply comes 30 miles from a reservoir in the hills. The leading exports are tea, rubber, coconut oil, and copra. The population, of very mixed composition, was 424,816 in 1953.

Colorado. A western mountain state of the United States, Colorado has an area of 104,247 square miles. The Front Range of the Rockies traverses the state from north to south, and there are 40 peaks of over 14,000 feet. The eastern part of Colorado is in the Great Plains area.

There are a number of rivers, all unnavigable, and some of them flowing through canyons or gorges of astonishing grandeur. The most famous is the Colorado, which rises in the Rockies and flows south-west into Arizona, where it cuts through the famous Grand Canyon (see article).

Denver (population 415,786), the capital of Colorado, is an important railway junction, as well as the clearing-house for the great gold, coal, iron, silver, copper, lead, and tungsten mines in the region. It is also a centre for tourists visiting the canyons and other natural wonders in the state, like Pike's Peak (14,108 feet), to the summit of which runs North America's highest railway, and Colorado Springs, with its romantically named Garden of the Gods and Cave of the Winds. In spite of the value of Colorado's mineral output, agriculture remains its mainstay, the production of sugar-beet being especially notable. The population in 1950 was 1,325,089.

COLORADO'S CAPITOL BUILDING

This building dominating Denver, capital of Colorado, is a reproduction of the Capitol buildings of various other States, even to the treble flight of steps leading to the entrance. The dome is covered with gold leaf.

Colosseum (pron. kolosē′*u*m). One of the grandest, most imposing buildings of ancient Rome, called officially the Amphitheatrum Flavianum, was begun about A.D. 75 and was finished five years later by Titus who had succeeded his father Vespasian as Emperor. The seats of stone, in 50 terraced rows, accommodated 87,000 spectators. Here were held the gladiatorial conquests, staged fights, circuses, and chariot races. Later, the throwing of Christians to the lions formed a spectacle for the people. According to technical writers and historians, a complicated system of water conduits and watertight doors permitted the flooding of the arena, to make a lake 281 feet by 177 feet. On this artificial lake galley-fights were staged for the amusement of the Roman citizens.

The Colosseum was renowned throughout the Roman Empire. All visitors from the provinces to Rome went to see it, and smaller amphitheatres in other parts of the empire were modelled on it. Ruins of these may be seen throughout the Mediterranean countries and well up into France (the Roman Gaul). There are notable examples at Verona, in Italy, and at Arles and Nîmes in France (see article on ROME for illustration).

Amphitheatres were either circular or elliptical, the latter shape being preferred for those where chariot races were regularly held. At first they were made of wood, but stone (mostly marble) structures became usual after fire had destroyed a good many of the wooden ones.

RUINS OF THE COLOSSEUM

Imposing even in decay is this remnant of the Colosseum at Rome. The carved niched wall is here seen floodlit during special celebrations. Excavation in the neighbourhood has added much to modern knowledge of Roman building methods.

The famous Rampart Range Road (upper picture) winds its way over the hills which separate Colorado Springs from Woodland Park. Gigantic swirls and bends make ascent easier and descent safer for motor vehicles. The lower picture shows Pikes Peak (14,108 ft. high) with Gateway Rock in the foreground. The rugged grandeur of this district awed the Indians, who called it by a name meaning the Garden of the Gods; it is near Colorado Springs.

Donald McLeish

GIGANTIC FIGURES OF THE PAST

Most of the colossi of the ancient world are known of only from descriptions of writers, but a few remain on site, like these 65-feet-high giants at Memnon, Egypt. Some fragments of colossi are to be seen in the British Museum.

Colossi (pron. kolos'ī). This is a general term used in antiquity for statues of great size (from this word comes the adjective "colossal"). The singular form is colossus, once known to every schoolboy as part of the name of one of the seven wonders of the world —the Colossus of Rhodes. This was a bronze statue of the sun-god Helios. It was made from the spoils left behind by Demetrius Poliorcetes when he raised his siege of the city of Rhodes. It was made in twelve years by Chares, who was instructed in the school of Lysippus, where the pupils were taught to prefer gigantic figures. It was about 120 feet high and stood near the harbour. About 22 B.C. an earthquake overthrew it, and it lay in pieces for 1,000 years. Then a Jewish merchant bought the scrap metal and converted it into armaments. (*See* SEVEN WONDERS OF THE WORLD.)

There were numerous colossi in the ancient world. Others in Greece were the Apollo of Kalmis; the Zeus and Heracles of Lysippus; the Zeus at Olympia; the statue of Athene in the Parthenon. In Rome there was a gigantic statue of Jupiter on the Capitol; a bronze statue of Apollo in the Palatine library; and the Nero colossus in the vestibule of his Golden House. The statue of Liberty (in full, Liberty Enlightening the World) at the entrance to New York harbour is a modern colossus (160 feet high). Other ancient colossi are in Egypt and sundry countries of Asia Minor. In the Far East are numerous gigantic statues of the Buddha, some of them in Tibet and China being as much as 100 feet high.

WHAT WE SEE *when* WE LOOK *at* COLOUR

Colour. It is a fascinating thought that if you were able to make yourself black all over you would be invisible. Do not try it, because it is nothing more than a fascinating idea! But black—a perfect, non-shiny black—reflects no light at all and so cannot be seen except as a contrast against a lighter background. You may have seen on the stage dancers with only their feet and legs visible, the rest of them being "black as night," with black tunics, masks, and gloves. The stage has a black backcloth, and the audience can see nothing but apparently disembodied legs and feet pirouetting about the floorboards.

It is necessary to appreciate the difference between seeing black and seeing white to understand why it is possible to distinguish between the various colours—why poppies appear to be red, the sky blue, and the grass green, and why a brown book can at once be picked out from all the other coloured covers on the bookcase shelves.

EXPLANATION OF FACING COLOUR PLATE

Colour Circle

In the right-hand figure at the top the colours of the spectrum are shown in a circle with the extra-spectral colour, maroon, joining the extreme red to the violet. Complementary colours then fall opposite each other on the circle. The pairs of complementary colours are: red and cyan, orange and blue, yellow and a purplish violet, green and extreme red or crimson.

Colour Mixtures

The left-hand figure shows the effect of shining three circles of monochromatic light—green, red, and blue—on to a white screen. Green plus red gives yellow; red plus blue gives maroon; blue plus green gives cyan; and all three together give white. Below is the effect of printing three circles of coloured ink one above the other. The yellow ink absorbs blue; the maroon ink absorbs green; the blue-green ink absorbs red; when all three are superimposed, they absorb all the light and produce black.

Additive and Subtractive Colours

In the lower part of the plate the full spectrum shows the composition of pure white sunlight. The three portions on the left show the part reflected by the so-called "primary colours" in pigments: the three on the right show the part transmitted by the "primary colours" of inks and dyes. If you mix the pigments 2 and 3, the colours add together and you get 7; similarly 3 plus 4 gives 5, and 2 plus 4 gives 6. On the other hand, if you superimpose the inks 5 and 6, both black patches will be subtracted from the full spectrum, allowing only the colours in 3 to be transmitted; similarly 6 and 7 will give 2 and 5 and 7 will give 3.


1. THE FULL SPECTRUM
2. BLUE
3. YELLOW
4. EXTREME RED
5. RED
6. MAROON
7. CYAN

To face page 479.

TRICKS THAT EYES CAN PLAY

In the colour plate opposite, the two circles at the top show the colours seen when the black-and-white discs described in the text are rotated slowly in white light. The yellow and blue stripes under them appear black and white when looked at in daylight from across the room. The two circles to the right are in fact the same colour—a neutral grey—but the effect of the brightly-coloured background is to tinge them with the complementary colour, so that the lower one looks slightly pinkish and the upper one slightly bluish. The effect is increased if you cover the whole area with thin white tissue-paper.

A more startling example of how the eye can see colours that are not there is obtained from the three lower pictures. Take the blue chicken first. Choose one point in the middle (say the chicken's eye) and look at it steadily in clear white sunlight while you count slowly up to twenty. It is very important to concentrate on one spot and not let the eyes wander. Then shift the eyes to the blank white space and wait. After a second or two a yellow chicken will gradually emerge on a bluish-green ground. It works best if at this stage you can relax the focus of your eyes as though looking *through* white paper, not *at* it ; and, of course, you can use any sheet of white paper, not necessarily just the space given here. The same procedure with the other two pictures should produce a rose and a Union Jack in their proper colours. The explanation is that during the first twenty seconds the colours you are looking at tire the particular receptors that absorb them ; then when you transfer to the white space the complementary receptors, which are still fresh, work much more strongly, and give the impression of the same shapes in the complementary colours.

Really, the red poppy, the brown book, the green grass, and the blue sky have no colours of their own. It is just the way in which they reflect parts of the light that shines on them. Going back to our black-and-white: these words you are reading illustrate the point. The paper appears white. The reason for this is that it is reflecting back to your eye most of the light that is shining on it. The letters appear to be black because they are not reflecting any light to your eye ; they are absorbing it. In other words, you are not really " seeing " the black letters but your eyes are appreciating that they are there because, in contrast with the light reflecting from the paper, they are " holes " in the light. If this page were put in really complete darkness, the letters would still exist in all their blackness, but they could not be seen because there would be no contrasting whiteness of the paper.

To sum up, the white page is " visible," and reflecting light to excite the retina of the eye (see article), while the black is " invisible " because it is reflecting no light. Some scientists believe that a page of printing would be more restful to read if it were made up of *white* letters printed on *black* paper, like a photostat, or chalk on a blackboard, but this opinion is not widely shared.

The light that makes the page seem white is really made up of all colours of the rainbow, and if it is allowed to shine through a prism it can be split up into its colours, so that they can be examined (*see* SPECTRUM colour plate in Vol. 7). At one end of the colour " plot " you will find violet and at the other end red. Between them there will be various colour shades of yellow, green, and blue. Exactly the same thing happens in a rainbow. The sun is shining, not through a prism in the form of a triangular-shaped piece of glass or crystal, but through the raindrops or moisture suspended in the atmosphere, which break up the light into the various colours.

To understand why the colours appear from what was originally white light, it must be borne in mind that the light we see is made up of a band of electromagnetic waves rather like radio waves but of very much shorter wavelength. To illustrate the difference, think of the B.B.C.'s long-wave Light Programme broadcasts which are transmitted on a wavelength of 1,500 metres. This means that from one wave crest to the next is a distance of 1,500 metres, not far short of a mile. The wavelength of light is so very much shorter that it is not even measured in millimetres but in Angstroms, a measurement equal to one hundred-millionth of a centimetre. The crest-to-crest measurement of the wave of red light (the longest in the visible waveband) is ridiculously small, 7,600 Angstroms, a minute fraction of a millimetre. The shortest wavelength of visible light is the violet end of the spectrum, 3,800 Angstroms. Above and below this visible spectrum there are the ultra-violet (very short wavelength radiations) and the infrared (very long wavelength) but these cannot normally be seen without special equipment, though they can be felt in the form of heat or can result in sunburn. (*See* INFRA-RED RAYS and ULTRA-VIOLET RAYS.)

The knowledge that the different coloured lights have different wavelengths makes it easier to see why white light going through a prism is broken up into the bands of colour. Different wavelengths are " bent " by the prism to a different degree. (*See* SPECTRUM.)

Why Grass is Green

The whole effect of colour comes from the wavelength (and consequently the colour) of light that is reflected from a substance and the colour which is absorbed by it. If a substance is greedy for colour, it will absorb everything that is shone on it, irrespective of wavelength, and will consequently reflect nothing back. The result, obviously, will be black. But if the substance is indifferent to light wavelengths and absorbs none of them, reflecting everything back, it appears as white. It is the chemical structure of the substance you are looking at, or the dyes or pigments used to make it choose between different wavelengths, that make its " colour." For instance, the chemical structure of grass is such that when sunshine falls on a field of fresh grass, wavelengths of light that represent the red, yellow, and violet parts of the spectrum are absorbed. What is left is what you see reflected—green light. The chemical structure of dyes operates in the same way : each dye is so made that it absorbs certain wavelengths to leave the " colour " that we see.

Colour is not really quite so simple as this, however. Anyone who has used paints or pastels will know that all kinds of remarkable shades can be obtained by blending. Grey, for instance, can be produced by a complex combination of red, orange, yellow, green, blue and violet. Or a little white can be mixed with a very deep red to give a delicate pink.

The painter's basic colours are red, blue, and yellow. Red mixed with yellow gives orange. But orange light can also be obtained by filtering the blue wavelength from sunlight. Some of the basic colour combinations, which you can demonstrate for yourself with a paint-box, are :

Red + Yellow = Orange
Red + Blue = Purple
Blue + Yellow = Green

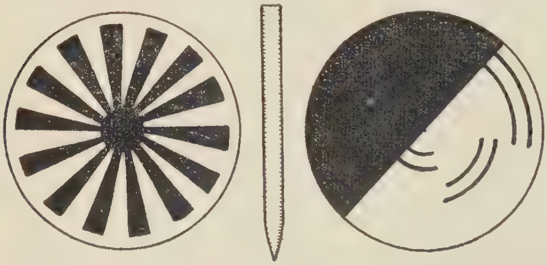
Then there are "complementary" colours which, when they are combined in the right proportions, appear as white. Bright red and blue-green are complementary, so are orange and blue, green and extreme red, yellow and violet.

The shimmering colour effect that is seen when sunlight strikes a thin film of oil on a wet pavement, or the "skin" of a soap bubble, is a quite beautiful thing. It results from the various wavelengths of light reaching the eye from different sources and in differing phase, sometimes reinforcing one another, sometimes cancelling one another out, so that the bands of colour seem to shift and change. One of the most beautiful examples is to be seen on a sunny day in the wings of a dragon-fly.

If instead of a single thin film there are a number, one below another, all the same thickness, the interference effects reinforce one another and become very much more brilliant. This is what happens on a butterfly's wings, which are covered with tiny scales of a horn-like substance called chitin, built up in very thin layers. It also accounts for the brilliant sheen in many bird feathers, fish scales, and snake feathers, and it can even be seen sometimes when the sunlight falls on human hair. The iridescence of pearls and of the inside surface of many shells is similiarly due to thin layers of calcium carbonate. In opals the iridescence comes from narrow fissures filled with water.

How the eye detects the colour of reflected light and passes the intelligence to the brain is not at present entirely understood, though the basic principles are known. Well over a hundred years ago a doctor, Thomas Young, worked out how it might be done, and to all intents and purposes he has been proved right in principle. He decided that in the retina of the eye there were three colour receptors, each sensitive to one of the colours red, yellow, and blue. Later, after experiments with lights, he suggested that the receptors were sensitive to red, green, and violet.

Though modern knowledge has refined Young's idea, which is called the trichromatic (three-colour) theory, it remains more or less correct in principle. It certainly lies behind modern methods of colour printing (in which in most cases three primary colours are printed one over the other; *see* PROCESS ENGRAVING), colour photography, and colour television.



Black and white patterns which when rotated (preferably in A.C. electric light) produce unexplained colour effects.

Later theories indicate that the colour receptors of the eye are not quite as simple as Young suggested and that in fact there are receptors capable of differentiating between seven different colours —red, orange, yellow, green, cyan, blue, and violet.

There remain, however, some effects which even the seven-colour theory will not explain. Two of them are quite simple to demonstrate. You have to cut out two cardboard discs, anything from 3 to 6 inches in diameter, and paint them in black and white (preferably with indian ink) as shown in the diagram. Then get a spindle of wood for each (the end of an old paint-brush or penholder does very well) and push it through a hole in the middle of each so that you can spin them like tops. When they are spinning quite slowly under electric light they will produce colour effects something like those shown at the top of the colour plate facing p. 479. Possibly these appearances may have something to do with the fact that the receptors in the eye are catching the light intermittently; but no one has yet discovered a complete explanation.

It has long been known that the way in which the eye responds to the light that reaches it is connected with the presence in the retina of a substance called visual purple (*see* EYE). This is a dye which bleaches to a pale yellow when light falls on it, and turns purple again in the dark. It seems clear that the chemical changes which produce the bleaching also affect the ends of the nerves in the receptors and so stimulate the electric pulses which the nerves carry to the brain.

Colours (MILITARY). Though in these days the colours of a British regiment are no longer carried in battle, the expression "serving with the colours" remains in general use as a symbolic phrase recalling that old custom.

Regimental colours come down from earliest days, when men lived in tribes and their chieftains carried poles having on the top a distinctive badge, usually some animal. The pole and badge indicated the chief's position on the battlefield and also acted as a rallying point if members of the tribe became separated. In the ancient Egyptian army standards or colours were carried by the royal princes, and in the Roman armies every legion had its standard, usually a square banner of silk or velvet surmounted by an eagle.

Medieval knights rode into battle with their family crests painted on their shields and embroidered on flags attached to their lances. When English armies were commanded in battle by the king in person, the royal standard showed his presence and position.

Military standards or banners were first called colours in England in the 15th century, when military leaders who did not own coats of arms adopted different coloured flags to distinguish their companies. These became symbols of honour and were considered to be disgraced by any crime committed in the company and not flown again until the offender was punished.

In battle every man in the company could see this rallying point. It was a great disgrace for a company's colour to be captured, and sometimes

IMPRESSIVE CEREMONY OF TROOPING THE COLOUR

On the Sovereign's official birthday, usually a day early in June, the Queen's, or King's, Colour of a battalion of Foot Guards is carried along the front of guards provided by regiments of the Brigade of Guards on Horse Guards Parade, London, the Sovereign taking the salute. Loyalty is the essence of the ceremony, symbolised in the solemn taking over of the Colour by the Ensign. Only the flags of infantry regiments are called colours in the army.

saving the colour in battle became more important than fighting the battle. During one of the many defeats suffered by the troops of Elizabeth I in Ireland, the captain of a company rode away with the colour and took great credit for having saved it, although his company was destroyed. But he was tried and executed, on the ground that in saving the colour he had deserted his men.

In the army of Charles II every regiment carried a colour for each company, together with the colonel's colour which bore that officer's family crest. Under William III the number of colours per regiment was reduced to three. In 1743 two became the rule, which mostly continues to-day.

Infantry regiments other than rifle regiments, which do not have colours, carry a Royal or first colour, called King's (or Queen's) Colour, and a second or Regimental Colour. The King's (or Queen's) Colour is the Union Jack, while the Regimental Colour is coloured like the regimental facings. It carries the badge and title of the regiment, and its battle honours, and any mottoes or other devices conferred by royal authority for services in the field. When the number of battle honours is more than nine, laurel wreaths are included in the design.

Before colours are presented to a regiment they are consecrated at a religious ceremony, and when a regiment is disbanded or receives new colours the old ones are placed in a church or some building associated with the regiment. Colours were always officially carried in action until 1880, when Queen Victoria ordered the custom to cease after a company of the South Wales Borderers had been wiped out in 1879 by a Zulu army at Isandhlwana while defending the Queen's Colour. Nowadays a regiment going on active service deposits its colours in a church or the regimental depôt.

On the official birthday of the Sovereign it is customary for regiments to troop their colours. The Brigade of Guards holds the ceremony on the Horse Guards Parade, London. It is a relic of the days when a company's colour was paraded each day before the soldiers so that they would recognize it. The parade was carried out to music called a "Troop," hence "Trooping the Colour." Eventually so much ceremonial was added to the parade that trooping the colour is now done only on special occasions.

Only the flags carried by infantry regiments are called colours in the army. Dragoon Guards carry guidons or swallow-tailed pennons in the regimental colours, while the Household Cavalry and cavalry of the line, except lancers and hussars, who do not have colours, carry standards. These square flags are crimson for the Household Cavalry, and in the regimental colours for other cavalry. The Royal Marines carry King's (or Queen's) Colours, and a Divisional Colour for each of the three divisions into which the corps is divided. The Royal Navy also have King's (or Queen's) and Divisional Colours, the latter being according to the chief manning

ports. The Royal Air Force has a King's (or Queen's) Colour and Squadron Colours. The Royal Artillery, Royal Engineers, and similar corps formations have no colours.

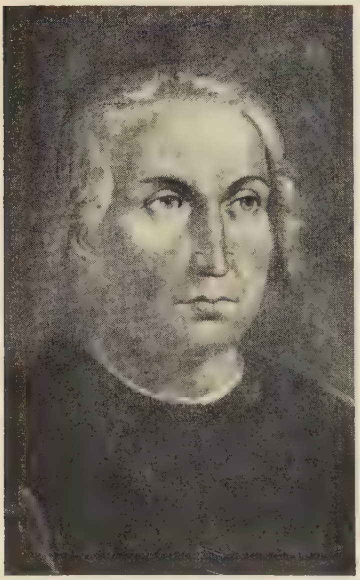
The term "colours" has several meanings besides the military one. One of the greatest events that can happen to a boy at school is to be awarded his colours for some sport or other. This sort of colour takes the form of a special cap, tie, hat, ribbon, blazer, or badge, which shows that the wearer is a member of the team or crew concerned. University undergraduates who represent their universities in sport also receive colours. At Oxford and Cambridge this is called "getting your Blue"—dark for Oxford, light for Cambridge. In horse-racing, colours refer to the distinctive jacket and cap worn by a jockey to show the ownership of the horse.

GREAT SAILOR *who* FOUND *a* WORLD

Columbus, CHRISTOPHER (1451?–1506). The birth-date of Crístobal Colón, as he was called in Spain, is uncertain : some say 1446, others 1451. His origin is obscure. It is known that he was born in Genoa and was the son of a weaver, but he was always reticent about his family and his biographers put this down to various causes. He was extremely ambitious, and may have thought that his humble origin would handicap him in his career. But some authorities believe that he came of a Catalan Jewish family which had settled in Genoa. This theory has much to support it, for Columbus lived in the days of the Spanish Inquisition, which was directed against Jews, as well as other "heretics." And indeed, in the year 1492, when he set sail for Asia and found the New World, a decree had been promulgated whereby all Jews were to be expelled from Spain. The very day fixed for the departure of the hopeful expedition of Columbus was the tragic day of embarkation for hundreds of thousands of exiled Jews.

But the sailing of Columbus's three ships, the *Santa Maria*, the *Niña*, and the *Pinta*, was the culmination of many years of effort on the part of their "admiral." He had been a sailor from boyhood, according to his own claims ; and it was some time between 1474 and 1478 that he conceived the idea of finding a western route to Asia. To discover this he needed the support of a sovereign power. Having failed to get this from King John of Portugal, he departed for Spain. Here at first he found the rulers, Ferdinand and Isabella, too much occupied with freeing their country from the Moors to give wholehearted attention to a foreign navigator full of hare-brained schemes. But when Granada, the last stronghold of their enemies, fell in April 1492, they eventually signed an agreement with Columbus. During his eight weary years of waiting (he had come to Spain in 1484) he had unsuccessfully approached Henry VII of England and Charles VIII of France.

Columbus set his price high ; he was to become admiral of the expedition and hereditary viceroy of any lands discovered. But before he saw a flickering light on an island shore—the first, small flame that reflected his burning faith in himself and his mission—his ships had voyaged for over nine weeks and the anxious sailors had tried hard to compel their captain to set a course for home.



Left, Laurent

COLUMBUS AND THE NEW WORLD

On the left is a reproduction of a painting of Christopher Columbus by the Italian artist Lorenzo Lotto. The original is in the Naval Museum, Madrid. The woodcut is an illustration to a pamphlet printed at Basle in 1494, describing "the islands lately discovered in the Indian sea." It depicts Columbus, who thought he had reached "the Indies," landing on the island of Hispaniola.

Columbus christened this island San Salvador, and took possession of it for Spain. (In the Bahamas, and now British, it is also known as Watling Island.) The natives, by great good fortune, proved to be people of mild and equable temperament, and Columbus continued his explorations, touching Cuba and leaving a colony of settlers, and a fort called "La Navidad," on the island of Hispaniola (afterwards Santo Domingo). Actually, since his own flagship had been wrecked, these men had been left as a garrison because there was no room for them on the other two ships.

The admiral reached Spain on March 15, 1493, and was given a wonderful reception. He had brought evidence that gold was to be found in the

COLUMBUS'S FLAGSHIP

Forming the expedition with which Columbus crossed the Atlantic in 1492 to discover North America were three ships—the *Santa Maria*, the *Pinta*, and the *Niña*. His own vessel, *Santa Maria* (a model of which is shown above), was of only 100 tons. The *Pinta* and *Niña* were mere cockleshells of 50 and 40 tons respectively.

New World. He had also brought a few " Indians " to show at court ; and these, sad to say, were unwilling guests.

A second and larger expedition was prepared, and Columbus sailed again in September 1493, reaching Dominica in November, and founding the city of Isabella on the island now called Haiti. When he revisited La Navidad, he was met by tragedy. The first " colony " of Spaniards had been butchered by the natives, to whom, it seems, they had shown great cruelty and whose hospitality they had abused.

Columbus now began to experience difficulty with the Indians and his own subordinates. Never at any time a good administrator, he escaped from his perplexities by pushing westwards. He explored the West Indies and the Caribbean Sea but did not reach the mainland. He believed that Cuba was the mainland of Asia and that he had opened a new way thereto.

On his return to Isabella he fell seriously ill for five months, from exhaustion and worry. Trouble with the natives came to a head in 1495 but Bartholomew, Columbus's brother, and the Spanish general, Ojeda, crushed the rebellion. Five shiploads of wretched Indian slaves were dispatched to Spain. This was ostensibly a punishment, but the Spanish pioneers had discovered that there was a good deal of money in this terrible traffic. This, however, was to bring them and their country into disgrace, and was one of the main causes of Columbus's fall from favour. He was cordially received in Spain on his return in 1496, and fitted out for a new voyage, during which he discovered Trinidad. But he was obsessed by his desire for gold, failed to restore order in the settlements, and allowed great cruelties. A storm of complaint now arose against him, and Ferdinand and Isabella dispatched a new governor, Bobadilla. He, provoked beyond measure by both Columbus and his brother, took the drastic step of sending them back to Spain in irons.

Columbus insisted on wearing his fetters until he stood in the presence of the King and Queen. They were shocked by Bobadilla's treatment, pardoned the admiral, and eventually equipped him for his fourth and last great voyage. But it is significant that among their new instructions there were warnings. Columbus was not to call at the settlements ; or, if he called " in passing," he was to leave as soon as possible : and he was to bring back no slaves.

He sailed from Cadiz in 1502. He touched at St. Lucia, and sailed along the coast of Honduras. His men were mutinous, but the colonists of Haiti refused assistance ; so he beached his ship at Jamaica and was compelled to stay there for a year. Here the conduct of his men antagonised the inhabitants, but Columbus saved his men by telling the natives that God would take away the moon if they did not treat the Spaniards well. He had remembered that an eclipse was due : it came just in time to reduce the terrified and superstitious Jamaicans to submission.

THE DISCOVERER'S FIRST TOMB

Columbus was first buried at Ciudad Trujillo, Santo Domingo ; later his body was transferred to Havana, and finally it was laid to rest at Seville in 1898. The tomb at Ciudad Trujillo is seen in the picture above.

THE NEW COMET AREND-ROLAND

After almost half a century, during which no bright comet could be seen from the northern hemisphere, two easily visible to the naked eye appeared in 1957. The comet Arend-Roland, named after its Belgian discoverer, was visible in April and May of that year. Comet Mrkos, first observed by the Czech astronomer Antonin Mrkos, was somewhat less bright than the Arend-Roland.

Relief came in June 1504. Columbus sailed for Spain in September and reached it in November. Too ill to go to court again, he died at Valladolid on May 29, 1506. His body was first buried at Santo Domingo, later transferred to Havana, and finally laid to rest at Seville in 1898.

So passed Columbus: arrogant and ambitious, greedy for gold and lacking in the science of government. But he lived at a time when men had a genius for faith. His belief that he was divinely inspired bordered on fanaticism and one of his unfulfilled dreams was to liberate Jerusalem. There is little doubt that his personality was cold and unsympathetic: but with all his faults and misdeeds he was a great navigator, a visionary, and a worthy product of an age of adventure and discovery. (For replica of the *Santa Maria* see BARCELONA, Vol. 1, p. 379.)

Comet. "God save us from the Devil, the Turk, and the comet" was a common prayer in Europe when the comet of 1456 appeared in the sky. Nothing startled our ancestors more than the unexpected appearance in the heavens of those peculiar objects with bright heads and streaming tails which we call comets. The name is derived from the Greek word *komētēs*, which means "long-haired."

Comets should be carefully distinguished from meteors (see article). Meteors flash across the sky in a few seconds, but comets move so slowly among the stars that they appear night after night in roughly the same position in the sky, just as planets do.

Though their origin and movements are still somewhat mysterious, the old superstitions about comets have now all been exploded. The earth has actually passed through the tails of a number of comets without any noticeable consequences. That was true of Tebbutt's comet in 1861, and also of Halley's comet in 1910.

It seems evident that comets are largely gaseous, and this theory is confirmed by means of the spectroscope. Only the nucleus, which appears as a star-like centre in the head, is thought to consist of relatively solid material. One theory is that the nucleus is actually a swarm of meteors surrounded by a cloud of gas and dust, and that the tail is a stream of gas.

The peculiarities of the tail still puzzle astronomers. It is not formed till the comet comes close to the sun. What is stranger, the tail *follows* the comet only when it is approaching the sun; as it leaves the neighbourhood of the sun, the tail *goes before* the comet. In other words, the sun seems to exercise some strong repelling influence, which first drives out the tail from the head, and then keeps it on the side of the comet opposite the sun. The most likely explanation is that the light from the sun is so intense that it actually exerts a pressure of repulsion on the tiny particles in the tail.

It used to be held that comets are really celestial visitors which wander into our solar system for a brief period in the course of a series of journeys from star to star. Astronomers are coming to believe, however, that all comets are members of the solar system, and that they have been formed from the thin outlying masses of a vast nebula from which the sun and planets were evolved. All observed comets revolve in orbits that make it certain that they did not come from outer space, though some are diverted out of the solar system by planetary attraction.

Comets fall into two categories—long-period and short-period. Long-period comets are usually very bright, with long tails visible to the naked eye. Short-period comets can be seen only with a telescope, and have hardly any tail.

The most celebrated of these peculiar wanderers is known as Halley's comet, after the famous astronomer whose prediction (in 1705) that it would return in about 75 years was verified. Since then it has appeared regularly at about that interval of time. An earlier appearance was in 1066, just before the invasion of England by William the Conqueror. At its last appearance, in 1910, it was disappointingly dim, but such fluctuations are not uncommon. Other famous comets are Encke's, which returns every three-and-a-half years; Biela's comet, which divided into two parts in 1846 and afterwards broke up into fragments too small to be

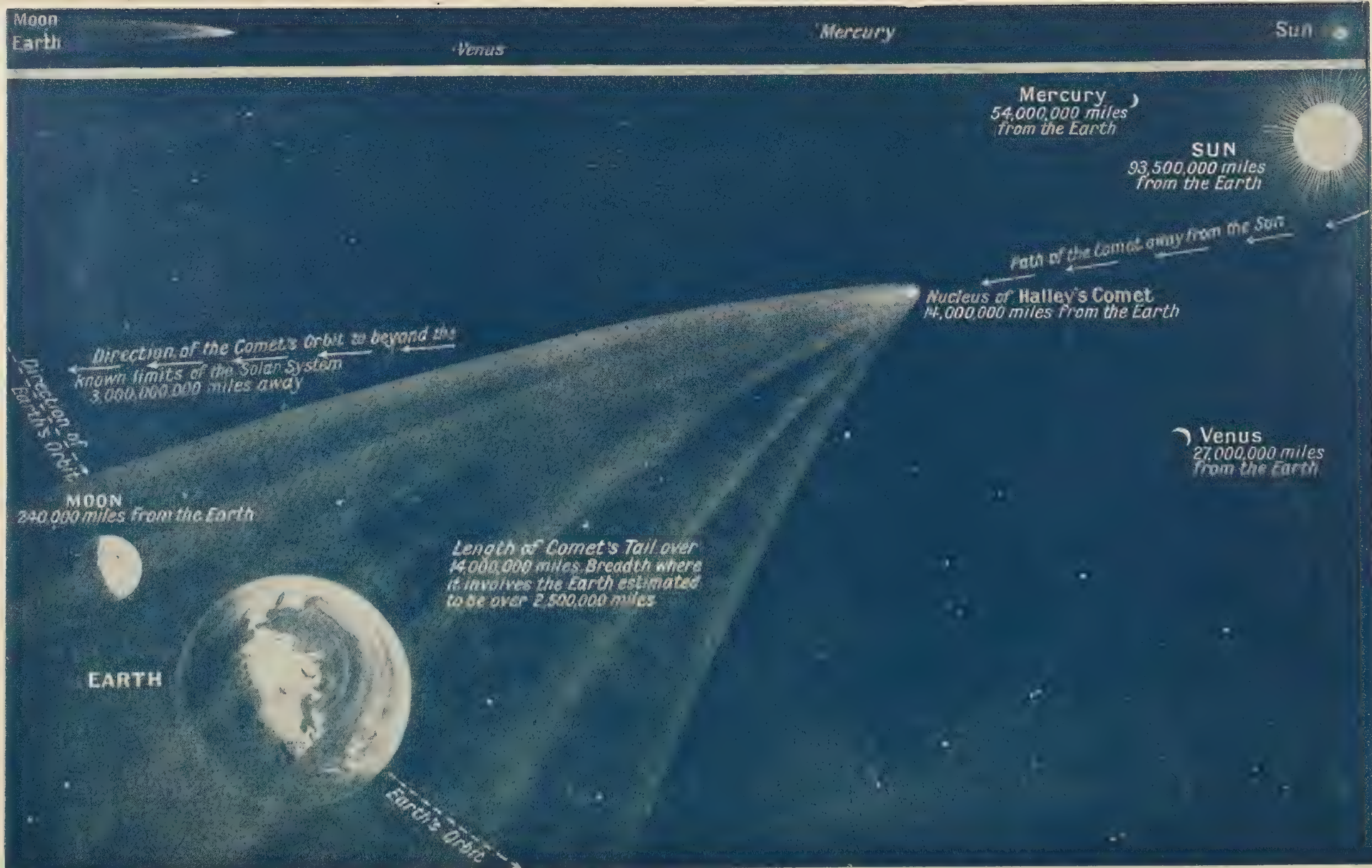
[*Continued on page 489*

A COMET ON ITS WAY ACROSS THE HEAVENS

This photograph shows Morehouse's comet, which was discovered at Yerkes Observatory, U.S.A., in 1908. The motion of t comet while the photograph was being taken causes the surrounding stars to be seen as streaks of light. The photogra was taken at Greenwich Observatory. About six weeks afterwards the comet was again photographed, from the Yerk Observatory, and by that time the tail was seen to be considerably longer, while the luminosity of the head had increas

This diagram shows some great comets that have visited the earth since 1811. Our forefathers regarded them with superstitious awe, and even in recent times there has been a fear that the earth could not pass unharmed through the tail of a comet; but it is now known that they are unsubstantial and harmless. Those shown here are rare visitors to the neighbourhood of the sun.

The great comet of 1811, which remained visible for 17 months, is not expected to return for 3,065 years. Donati's comet will not again approach the sun for 2,040 years ; and it will be from 6,000 to 10,000 years before Coggia's comet of 1874 is again seen from the earth. The speed of comets depends upon their distance from the sun and may reach 400 miles per second.



THE COMET WHICH THE NORMAN CONQUERORS REGARDED AS AN OMEN OF VICTORY

The most famous comet is Halley's comet, so called because in 1705 the astronomer Edmund Halley identified it with the comet seen in 1531 and 1607, and predicted its return at a period varying between 75 and 80 years. His calculations proved to be correct. Its last return was in May 1910. Halley's comet is almost certainly that which appeared in [illegible]

seen (some reach the earth every year in November in the form of shooting stars); and Donati's comet (1858), the brightest of all the 19th-century comets.

The nucleus of a comet varies in diameter from 100 miles to that of the earth, while the diameter of the head, or "coma," may extend anywhere from 10,000 to 100,000 miles. The tail is enormous; at its shortest it is measured in millions of miles.

The speed of comets depends entirely upon their distance from the sun. At the earth's distance from the sun a comet would travel about 20 to 25 miles per second.

Communism. A passage in the Acts of the Apostles reads: "And all that believed were together, and had all things common; And sold their possessions and goods, and parted them to all men, as every man had need." The early Christians thus practised a simple kind of communism. The experiment was short-lived. Yet the idea of communism, of living together in brotherly love and sharing possessions, continued to haunt the imaginations of men. Sir Thomas More in his book *Utopia* dreamed of the ideal state, in which there would be no rich and no poor, and all would be equal and happy. The poets Coleridge and Southey, excited by the idea of brotherhood expressed in the French Revolution, planned a communistic settlement in America, but they could not raise enough money for the scheme.

However, the communism with which the world is familiar to-day is different from that ideal community of which men of letters dreamed. Indeed, Karl Marx (1818–83; see article), the father of modern communism, despised the Utopian visions of earlier writers. He was a German-Jewish philosopher, who lived in London from 1849 till his death in 1883. Marx did not imagine an ideal state; he studied history and held that he was merely relating what had happened and what was bound to happen in the future. By his account, the story of mankind was one of struggle—between patricians and common people in Rome, for example, or between landowners and serfs in the Middle Ages. Always on one side there were the oppressors and exploiters, the owners of land and capital, and on the other side, the oppressed and exploited, the workers who had no property and nothing but their wages.

In modern times, wrote Marx, the class struggle was fought between the "bourgeoisie" and the "proletariat." By the bourgeoisie Marx meant manufacturers, financiers, and property-owners, while the proletariat were the mass of the working people. The workers produced goods, but they were paid only enough to keep them alive; the surplus value of what they produced was appropriated by the employers or capitalists. In the conflict between workers and capitalists, the victory of the workers was inevitable, Marx taught. The working class would get poorer and poorer, and the rich would get richer. When the misery of the workers became unbearable, they would revolt and forcibly overthrow the ruling class. The concentration of workers in large towns would increase their power and help to bring about a revolution; and Marx also believed that the capitalist system would dig its own grave through economic slumps and through the intense rivalry between competing capitalists.

When the communist revolution triumphed, the workers would take factories, land, railways, and all other means of production into their own hands. There would be no private property. With the victory of the workers the class struggle would come to an end and the state would "wither away," that is, there would be no need for police and armed forces, who existed to carry out the will of capitalists. The communist state would be classless. Each person would serve the community according to his ability and receive a share of the common goods according to his need.

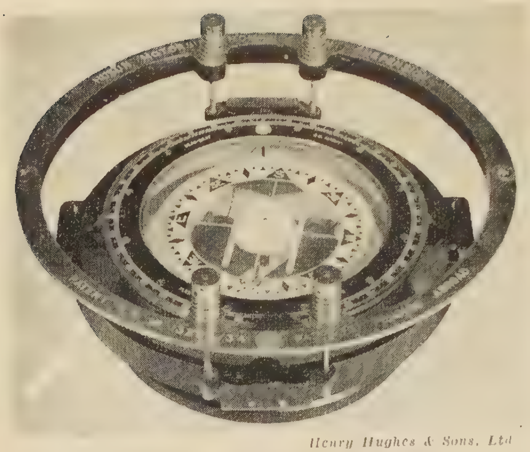
The hollowness of nearly all Marx's premises and prophecies was exposed as long ago as 1905 by Eduard Bernstein (1850–1932). Nowhere has the perfect communist state, as Marx described it, been realized. Since the revolution of 1917 Russia has been ruled by the communist party based on Marx's ideas, but the events have not followed the course Marx expected. There is still a state in Russia with powerful police and armed forces at its disposal, even though private property has been abolished. What is known as the dictatorship of the proletariat exists in the Soviet Union, and this is said to be necessary during the transition to ideal communism. Stalin and his successors ruled, in theory, for the benefit of the proletariat. According to the communists, a strong central government is needed to organize production in the country and to defend it against the plots of those who would like to return to the capitalist system. On that account the Russian people are denied freedom and are entirely at the mercy of the men at the head of the Soviet communist party.

Although Marx's teaching was wrong in some ways—the lot of workers under capitalism has not got steadily worse, as he prophesied—and although it has led to much violence and cruelty, it is important to understand it because of the profound effect which the Marxist form of communism has had, and still continues to have, on the politics of the whole world of to-day.

Compass. For thousands of years after they had learned to build boats, men seldom ventured more than a few miles from the coast, because once they were out of sight of land they had the greatest difficulty in finding their way back again Not only did they not know in what direction to sail, but they could not even be sure if they were sailing in a straight line. Occasionally they got some sense of direction from the positions of the sun or the stars, but if the sky was covered by clouds the unfortunate sailors were in the condition of men groping about in a dark room. That is why the great civilizations of the past knew very little about one another. The ancient Greeks and Romans voyaged chiefly across the narrowest parts of the Mediterranean between Europe and Africa, and their only links with China and India were caravan trails.

It was not until the introduction of the magnetic compass that mariners were able to sail with confidence to far-off lands. The magnetic compass is a simple instrument, and the wonder is that it did not come into use long before it did; for the behaviour of magnets (*see* MAGNETISM) had been known for centuries.

Some form of compass was invented nearly



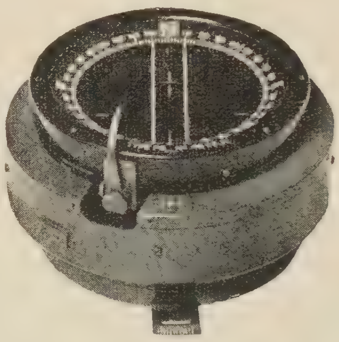
Henry Hughes & Sons, Ltd

MODERN TYPE OF COMPASS

One of the difficulties in steering a true course for sailors of old was the swinging of the compass card with the movements of the ship. In the compass above, the card is suspended on a pivot in a bowl filled with a special liquid which slows the swinging movement. Fine wire filaments are attached to the card, which, when moved through the liquid, also help to reduce the swinging.

3,000 years ago by the Chinese, who found out that if a thin piece of steel was rubbed with a piece of magnetite one of its points would turn to the north. This was a most important discovery for travellers, because once a man knew where the north lay he could find south, east, or west. At first the Chinese used the compass only for land travel, and there is no record of their having attempted to navigate ships with it until the third century A.D.

The first European seamen to use the compass are thought to have been the Norsemen, who in the 10th and 11th centuries made voyages to Greenland. But for a long time most mariners were too superstitious to trust themselves to the guidance of a compass, believing that its property of pointing to the north was due to witchcraft. There is an exciting story in *Puck of Pook's Hill*, by Rudyard Kipling, which brings out this point. By the 15th century the instrument was in general use at sea, so making possible the great voyages that discovered South and North America and the islands of the Pacific Ocean.



COMPASS FOR AIRCRAFT

Much the same in principle and construction as a ship's compass, this instrument gives reliable readings only when the aircraft is flying a straight and level course.

In its earliest form as used by European seamen, a compass consisted of a magnetised needle supported on two straws floating on the surface of a bowl of water. This was a very crude affair indeed, and in a rough sea the needle was apt to be broken off the straws. Then someone thought of mounting the magnetised needle on a pivot that was fixed in the centre of a circular card marked North, South, East, and West. The compass was held so that one end of the needle pointed north, after which the other geographical directions could be read from a scale on the card. This is the principle still used in the pocket compass.

But the pivoted needle had the great disadvantage that it wobbled about a great deal before coming to rest and indicating north. This was eventually overcome by attaching two or more magnetic needles side by side beneath a round sheet of paper or mica. Let into the centre of the case is a small disc of agate with a round notch in the middle so that the compass card can rest on the point of a hard steel needle fixed to the bottom of a bowl filled with a mixture of alcohol and water. The liquid slows down the swinging movement of the needle and also acts as a shock-absorber to prevent the card from being knocked off its pivot by bumps against the bowl.

The compass bowl is enclosed in an outer case, and this in turn is supported on bearings or pivots called gimbals. These are so arranged that they allow the compass box to tip freely in any direction and so remain level however much the ship rolls or pitches. The whole apparatus is then mounted on a pedestal called the binnacle, in front of the helmsman.

Formerly the compass card was marked North, East, South, and West, with the spaces between these "cardinal points" divided into half points, quarter points, and eighth points, making 32 points altogether. The sequence of the named points, which are still used, is as follows: N., N. by E., N.N.E., N.E. by N., N.E., N.E. by E., E.N.E., E by N., E., and so on for each other quarter. "Boxing the compass" is repeating the 32 points correctly.

Nowadays the card is divided into 360 degrees and retains the old lettering only for the four cardinal points and the four half points. Across the face of the glass covering the compass is drawn a black line, called the "lubber's line," exactly in line with the level of the ship. The needle and compass card are not affected by sideways movements of the ship, so that the needle continues to point northward. Consequently, by reading the bearing or point on the card which comes opposite the "lubber's line," the helmsman can at any moment see in which direction the ship is going.

If he is to steer a course 225 degrees, which is south-west, he turns the ship by means of the rudder until the point on the compass card marked 225 degrees is exactly in line with the "lubber line" on the compass box.

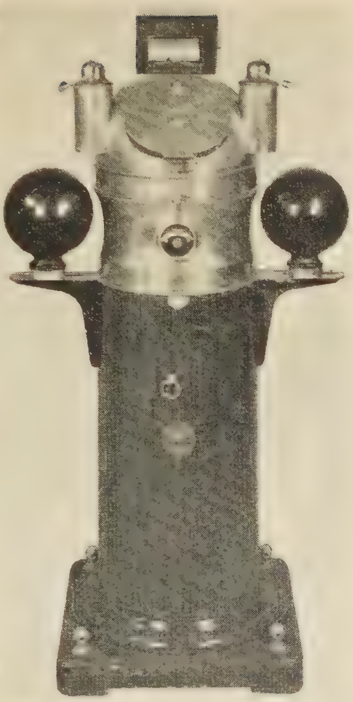
Unfortunately a steel ship, while being riveted and otherwise hammered during construction, itself becomes a permanent magnet. As a result the magnetism of the ship will attract the magnetic needle of the compass and so prevent it from pointing towards the north. This is called deviation of the needle. To overcome deviation, balls of soft iron and small magnets are placed near the compass in such positions that they pull the needle exactly as strongly as, and in the opposite direction to, the magnetism of the ship.

To fix the correct position and magnetic strength of the balls and magnets, the ship is periodically

"swung for adjustment of compasses." This is done by pointing the bow of the ship successively north, south, east, and west, and at each point taking a bearing of some prominent object, the magnetic bearing of which is known. The iron balls and magnets in the binnacle are then adjusted until the compass shows the correct reading in every direction.

Even when a ship has been swung for compass correction, there is always a certain amount of variation in the magnetism of the hull because the earth's magnetic force varies in different parts of the world. This may affect the accuracy of the compass needle. These errors are overcome by the gyro-compass, which is described in the article GYROSCOPE.

Aircraft compasses are very similar to those in ships, except that the needles are not fixed to a card, but to a nickel silver framework called a system. The magnetism from the metal parts of the aircraft is counteracted by small magnets placed under the compass, which is not mounted in gimbals and has no binnacle. Consequently an aircraft's magnetic compass gives a true reading only when the aeroplane is flying level.



Henry Hughes & Sons, Ltd.

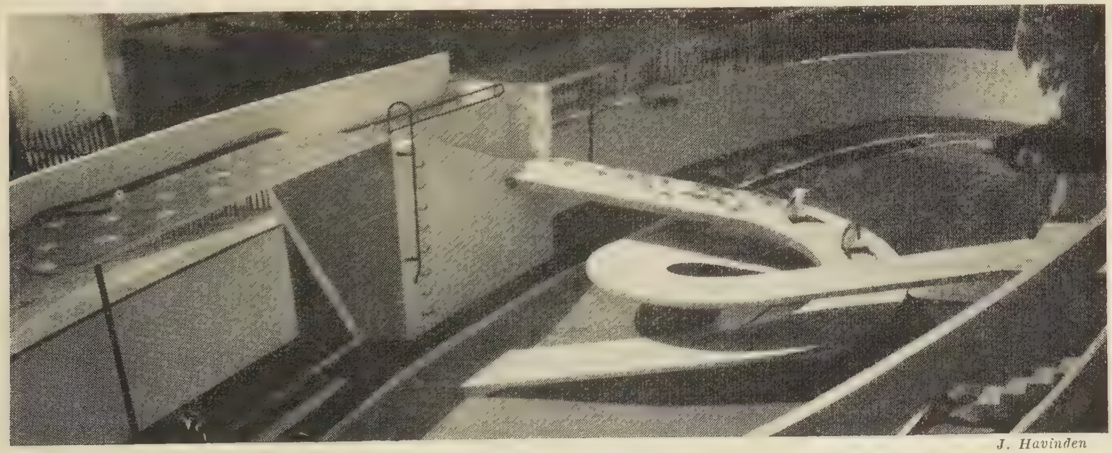
COMPASS IN A SHIP

Readings of the ship's compass are reflected in the vertical card reader on top of the stand in which the compass is carried. The cast-iron balls prevent the magnetism of the ship's iron or steel from affecting the compass.

Concrete. Concrete was first used by the Romans, who used it in the foundations of their bridges and in structures such as the dome of the Pantheon in Rome. Many centuries later, Wren built the dome of St. Paul's Cathedral in concrete with rings of iron chains to bind it together. To make the concrete for these early buildings, hydraulic lime (*see* CEMENT) was used, but modern concrete is made with Portland cement. It hardens into a rock-like mass which reaches its working strength in from three to 28 days, depending on the cement used, and gradually increases in strength for years afterwards.

In making concrete, one starts with a quantity of sand and gravel or broken stone, carefully graded from small to large so that the grains will pack together as closely as possible with very small spaces or "voids" between them. This is generally called the "aggregate." A quantity of cement, about one-third to one-sixth of the amount of aggregate, is then added. This quantity must be more than enough to fill all the voids in the aggregate. The cement and aggregate are then thoroughly mixed by hand or in a mixing machine. Water is then added, and the mixing continued until all the cement is wetted and every grain of aggregate is coated with wet cement. As little water as possible is used, because too much weakens the concrete.

At this stage the concrete is like a mass of porridge; but after a few hours a chemical reaction takes place between the cement and the water, and the concrete begins to "set" or stiffen like a jelly. Before this happens, the wet concrete must be placed in moulds or "shuttering" to ensure that it will have the proper shape when it hardens. It is sufficiently fluid to adapt itself to any shape the architect may desire. (The illustration of the penguin walk at



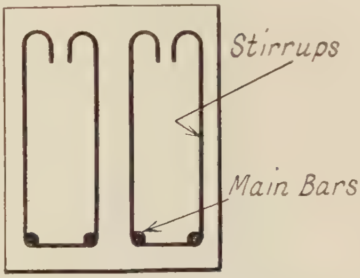
J. Havinden

CONCRETE PATH FOR PENGUINS

Another good example of how concrete can be formed into the most difficult shapes is shown in this photograph of the penguin pool at the London Zoo. Reinforcing rods are embedded through the length of the concrete paths to prevent them from cracking or collapsing under their own weight. The birds evidently enjoy their parade.

the London Zoo shows what can be done in this way.) The shuttering consists of a temporary timber or metal box whose inside shape is the same as that required for the outside of the concrete. For a hollow structure, such as a tank, another set of shuttering is erected inside the first, to give the inside shape. The wet concrete is placed inside the shuttering, each batch being bonded to the previous one by working spades up and down through them both. This also consolidates the concrete. Instead of spading, vibrators are often used to-day. These give the wet concrete several thousand tiny shocks per minute, bonding and consolidating it very effectively, and expelling any surplus water. When the concrete has hardened, the shuttering is removed, or "struck." Fig. 1 shows the shuttering for a reinforced beam.

Modern concrete has great strength in compression, and can take crushing loads up to 6,000 lb. per square inch. It is cheaper and easier to place in position than stone or brick masonry, is more easily made watertight, and when properly made is virtually everlasting.



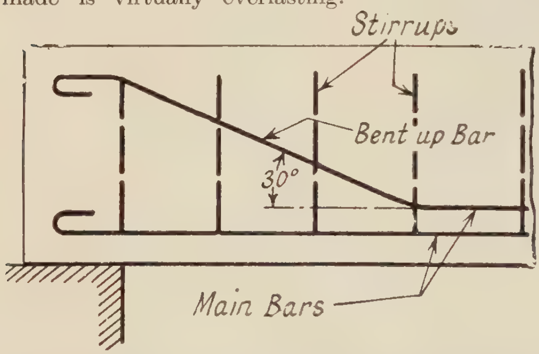


Fig. 1. This diagram shows how steel bars are arranged in a concrete beam so that it can carry great weight along its length. The main bars are placed longwise so that they resist the pressing-down force. The bars are joined together by shorter U-shaped bars called stirrups (shown in the small top drawing), which serve to prevent the concrete from splitting along its length.

It is therefore becoming the favourite material for massive structures such as dams, breakwaters, quay walls, bridge piers, and retaining walls.

In reinforced concrete, steel bars are placed in the concrete near the bottom of a beam. The reason for this is given in the paragraph on beams in the article on BRIDGE. It is shown there that the bottom of a loaded beam is stretched, or "in tension," while the top is pushed in, or "in compression." Concrete is much cheaper than steel, but though strong in compression, it is weak in tension, while steel is much stronger in both tension and compression. Steel bars are therefore placed in the bottom of a beam to take the tension, or pull. Concrete columns often have vertical steel bars to carry some of the load and so allow the columns to be thinner. Figs. 1 and 2 show the arrangement of steel bars in beams and columns. The stirrups and hoops and the bent-up bars hold the concrete together and keep it from splitting. The two upper photographs opposite show reinforcement assembled before the concrete is placed around it. The shape, size, and position of each bar is fixed by precise calculations.

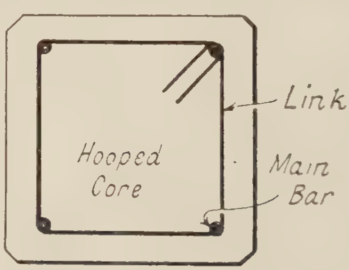
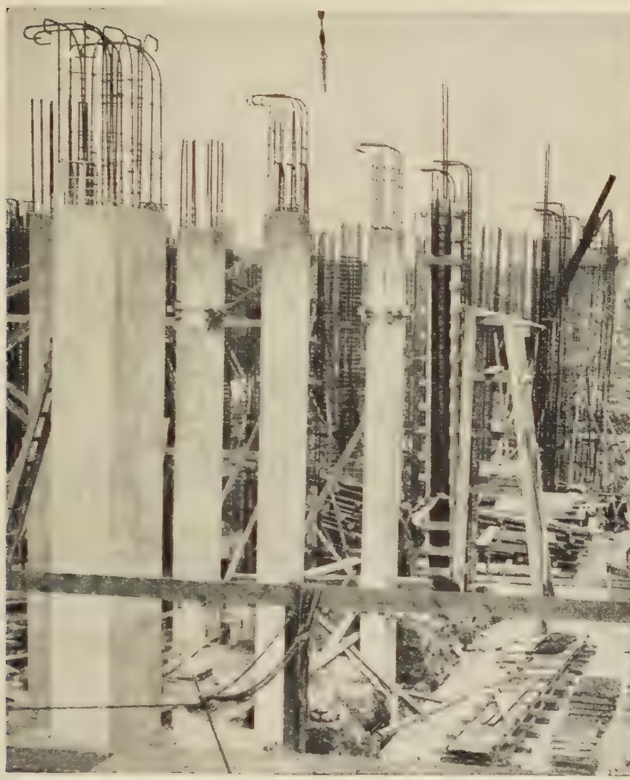


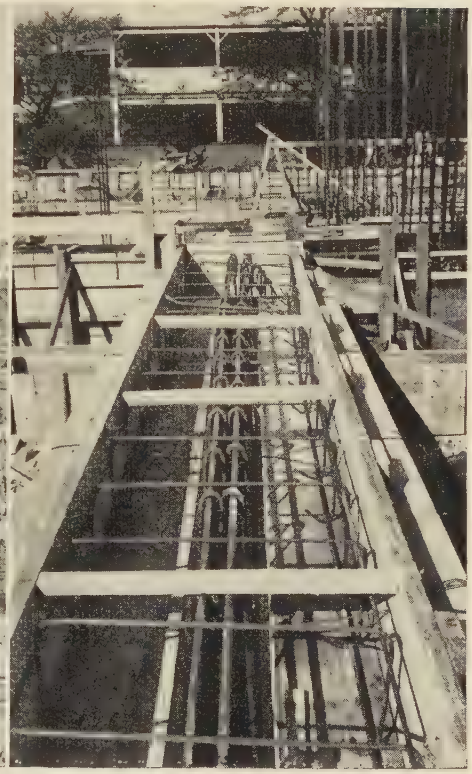
Fig. 2. A concrete column is the opposite of a concrete beam and has to bear a heavy downward weight on a small surface. This diagram gives a view down the length of a concrete column. The heaviest steel bars are arranged upright and are joined by smaller bars to stop them from buckling or bending.

Since reinforced concrete can withstand bending and is relatively cheap, it is now often used in place of steel. Big many-floored buildings are erected with reinforced concrete columns, beams, floors, and roofs. The first of these in England was the General Post Office at St. Martin's le Grand, London. Arched or beam bridges—such as Waterloo Bridge, London—are usually of reinforced concrete. It is used for water tanks and water towers, for chimneys and domes, for modern roads, and for everything in which strength and permanence are necessary. The caissons which were floated across the English Channel in 1944 to form the Mulberry Harbour (see article) were made of reinforced concrete.

A great many things are now made of "precast" concrete. These are cast in a workshop or yard in steel moulds. The concrete is placed in the moulds and is vibrated or subjected to heavy pressure. This consolidates it and expels any excess of water, and results in a very strong concrete. As the moulds can be used many hundreds of times, they add very little to the cost of the finished articles, so that these can be ornamented by panelling, mouldings, and so forth. Common products of this kind include lighting standards, fence posts, kerbs and gutters, building blocks, and drain-pipes. Most of the "stone" facings on the new buildings in the City of London are artificial stone, which is a special form of precast concrete made of white cement and selected white sand.

When the shuttering is removed from concrete, the outside faces of the sand and gravel grains are coated with cement, and ordinary Portland cement has a dull grey colour which is not attractive. There are several ways of improving the appearance of concrete. If the aggregate has a good colour, it can be exposed by coating the shuttering with a substance which removes the outside cement (Twickenham Bridge is an example), or by chipping the surface, or by grinding it with a carborundum stone. Coloured cements ranging from white to brown or deep red are also now available. The Dorchester Hotel, London, well shows the effect to be got by using coloured cement





Cement and Concrete Association

Here two photographs show different stages in building with reinforced concrete. On the left are partly-finished columns or uprights which will support a viaduct. The columns in the foreground have been covered with concrete for a portion of their height, leaving the steel bars sticking out of the top. Next comes the steel frame of a column partly enclosed in shuttering, and when the latter is closed the concrete will be poured in. On the right is the shuttering and rod framework ready for pouring in concrete to make a foundation beam for a large building.

Staveley Iron and Chemical Co., Ltd.

Not only is this huge tank made of reinforced concrete, but the 20-foot stilts raising it off the ground are of the same material. The tank is 130 feet in diameter, and 19 feet deep, and it will hold 1,500,000 gallons of water.

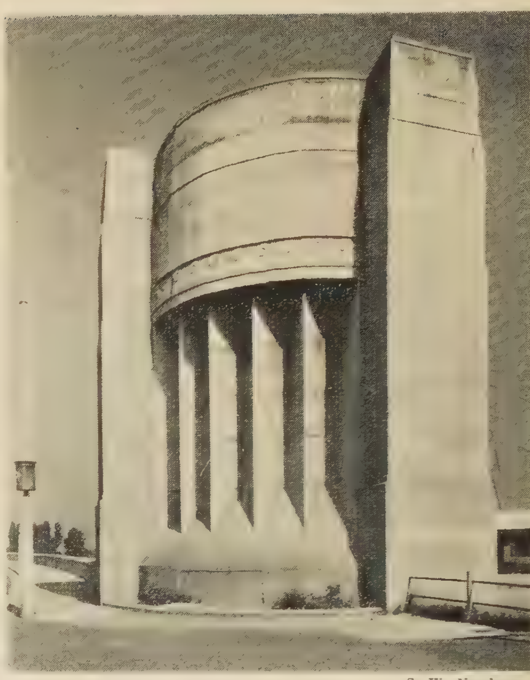
with pleasantly coloured aggregate, and then grinding the surface.

In pre-stressed concrete, the concrete at the bottom of a beam is kept in compression by arranging for the bottom reinforcing bars to be in tension. In pre-tensioning, the reinforcement is kept stretched by a force of several thousand pounds per square inch while the concrete is being placed. When that has hardened, the tension is taken off; and the steel tries to shorten and thus compresses the concrete. In post-tensioning, holes are left through the beam when it is cast; and bars are threaded through these when the concrete has hardened. The bars are stretched, and then wedged tightly against the ends of the beam. When the tension is taken off the bars, they shorten and compress the concrete. Pre-stressed beams are much stronger than normal reinforced beams of the same size.

Condor. Largest of all the vultures, the condor, *Sarcorhampus gryphus*, makes its home thousands of feet up in the Andes of Peru and Chile. The full-grown bird has a wing expanse of from 8 to 11 feet. It feeds chiefly on carrion, but attacks lambs and young calves.

When an animal is dying on the plain below, the condor will hover, watching, so high in the air that its great bulk looks a mere speck. Its eyesight is as remarkable as its powers of flight. Suddenly it swoops straight down, and from all directions others come to join it at the feast.

In its plumage the condor is usually black, with white patches on the wings. The head and the neck are bare, the skin is discoloured and repulsive, and there is a white frill of down at the base of its neck where the feathers begin. On its head the male condor has a wrinkled fleshy crest on the back of the beak and forehead. The female condor lays two white eggs on some inaccessible ledge, and they hatch in about seven weeks. The young birds develop slowly; they are not able to fly until they are about a year old.



S. W. Newbery

CONCRETE MOULDED TO SHAPE

When buildings are of stone, decorations or other shapes must be slowly cut with tools. But as concrete is a liquid it can be poured into any shape required, provided that the shuttering used has been arranged with the shapes worked out on the concrete in reverse. This photograph shows the restrained and tasteful decorated concrete entrance to the Lea Valley viaduct, near London.

CONDOR, LARGEST OF THE VULTURES

In the Andes the favourite haunts of the condor are at elevations of from 10,000 feet to 16,000 feet; but the bird is often seen on the shores of the Pacific, especially during the rainy season. A few sticks form the nest, which is perched on a high ledge; and usually there are two eggs, hatching in about seven weeks.

Confirmation. Entry into membership of almost every branch of the Christian Church is by the rite of baptism (see article). This is supplemented and completed by the rite of confirmation (from the Latin word *confirmatio*, strengthening), a service of consecration and dedication which originally followed immediately after baptism. To this day, in the Greek Church, confirmation is part of the baptismal service. In the Anglican Church the "Order of Confirmation" consists of a public renewal, by those who have reached years of discretion, of the vows made on their behalf in their infancy by their baptismal sponsors, or godparents, and the invoking of God's blessing by the laying-on of a bishop's hands.

In the Roman Catholic Church confirmation is one of the seven sacraments. A sponsor is necessary. It is usual at a Roman confirmation to take an additional name, that of some saint chosen as the candidate's special patron.

In the Lutheran Church the main feature of confirmation is a public profession of faith

after examination in Christian doctrine. The various Free Churches do not acknowledge confirmation as a separate rite from baptism.

Confucius (551 or 550–478 B.C.). When the Chinese philosopher Confucius (pron. konfū'shus) and his disciples were on a journey, they passed a graveyard where a woman was weeping at a newly-made grave. Confucius sent to ask why she wept. She answered, "My husband's father was killed here by a tiger, and my husband also, and now my son has met the same fate." When they asked her why she did not leave so fatal a spot, she answered that in this place there was no oppressive government. "Remember this, my children," said Confucius to his disciples, "oppressive government is fiercer and more feared than a tiger." In such wise teaching Confucius spent his life, trying to right the many wrongs of the feudal day in which he lived, and to bring men to a right mode of living and a veneration for the teachings of the wise men of old. He always said of himself that he was "a transmitter, not a maker"; and he collected and edited the poetry, the music, and the historical writings of the older days (of fifteen centuries before his time), which he considered the golden age. Confucius made no claim to being more than a man: after death he was venerated, and temples arose to his name in every city of China. His teachings are among the most profoundly respected of the sundry faiths of China, and Asia contains about 350 million Confucianists. He is commonly referred to as China's First Sage.

CONFUCIUS, SAGE OF CHINA

Confucius is the Latin form of K'ung Fu-tzu, meaning the philosopher Kung. He lived in the sixth and fifth centuries B.C., and his sayings and teachings are profoundly respected by many of the Chinese.

Though Confucianism is usually called a religion, it is rather a system of good conduct, for Confucius did not talk of God but of goodness. Indeed, he taught nothing about any god, saying simply: "Respect the gods, but have as little to do with them as possible." His entire attention was centred on making men better in this life, and his analects (literally "things gathered") are wise sayings not unlike the Proverbs in the Bible. He taught men to be honest, upright, faithful, and obedient to those in authority. His most famous rule of conduct is the golden rule (in negative form, which in Chinese is an emphatic construction) which says: "Do not to others what you do not wish them to do to you." To Confucius, beautiful manners are essential, and good manners and good music, ruling the emotions, are allied.

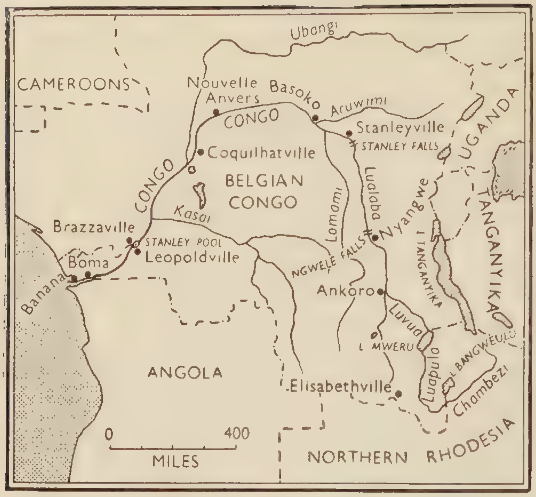
In some ways the teachings of Confucius have been good for the Chinese people. But in other ways the country has been held back by his teaching that the past is more perfect than is the present or than the future can be, and that worship of one's own ancestors is an act of piety, and unquestioning submission to the state a supreme duty. As a result the Chinese usually thinks that what was good enough for his grandfather is quite good enough for his children. During her long history China has more than once rebelled against Confucian precept, but has always returned to it.

The word Confucius is the Latinised form of this philosopher's Chinese name, which was K'ung Fu-tzu, meaning the philosopher Kung. He was born in the state of Lu, in what is now the province of Shantung, of illustrious lineage, though his father was poor. He lost his father when he was three years old. At the age of 19 he married, and after having held various small positions he started at 22 on his real life-work of teaching the precepts of virtue and social order.

After some years of such teaching and travel he settled in Shantung and there spent 15 years. In 501 B.C. he was appointed governor in his native state (Lu) and later became chief criminal judge. But, disgusted with the way in which his country was ruled, he resigned and spent more than a dozen years wandering from land to land, teaching and debating.

When, at the age of 68, Confucius at length returned to the state of Lu, he refused to take public office again. Instead, he settled down quietly in a valley, surrounded by his disciples, and devoted his time to the completion of his literary tasks and the instruction of his followers. He died in 478 B.C. and was buried in the cemetery outside Kuh-fu, resting place of all the Kung clan.

Congo, River. This great river of equatorial Africa is the sixth longest in the world, yet quite late in the 19th century it was shown in the geography books as an insignificant stream. Its total length is more than 3,000 miles, and it drains an area of 1,500,000 square miles. Its



BASIN OF THE RIVER CONGO

The Belgian Congo has an area of over 900,000 square miles, and contains nearly the whole basin of the Congo River. The Congo rises in Northern Rhodesia.

basin is a vast region of dense forest and open prairie, with settlements many miles apart.

By natural features and adaptation to commerce the Congo is divided into the lower, the middle, and the upper river. Rising in the north of Northern Rhodesia, it is known as the Chambezi and flows south-west to Lake Bangweulu. It leaves the lake as the Luapula, and swings round from flowing due south to due north. Entering Lake Mweru, it finally leaves Northern Rhodesia and flows out as the Luvua, receiving the Lualaba from the south at Ankoro. As the Lualaba it flows north to Nyangwe, below which place it is known as the Congo. The Stanley Falls, near Stanleyville, mark the start of the Middle Congo, which flows in a great semicircle north-west, west, and south-west through Basoko, Nouvelle Anvers, and Coquilhatville to Stanley Pool. In this section it receives its main tributaries, among them the Aruwimi and Ubangi from the north and the Lomami and Kasai from the south. From its junction with the Ubangi the Congo forms the boundary between Belgian Congo and French Equatorial Africa. The Lower Congo flows south-west through Leopoldville, Brazzaville, and Boma on its way to Banana, on the West African coast. Though the river is mainly in Belgian territory, part of the north bank is French and the south bank at its mouth is in the Portuguese territory of Angola.

It was a Portuguese explorer, Diogo Cão, who discovered the mouth, in 1484–85. In 1818 a Captain Tuckey, sent out by the British government, explored the estuary and went 172 miles up the river. When its great inland course was finally traced, however, it was by expeditions entering Africa from the *east* coast. David Livingstone (see article), between 1867 and 1871, while exploring between Lakes Nyasa and Tanganyika, found a river flowing to the north, which he thought to be the Nile. Five years later Henry M. Stanley (see article), exploring in the same region, gazed on the mighty stream, and, following its course to the mouth, proved it to be the Congo.

Congo States. The great basin of the Congo River in Central Africa is divided politically between Belgium and the French Community.

The area of the Belgian Congo is about 905,000 square miles, and its population is about 12,660,000 of whom fewer than 100,000 are white. Great Britain, which contains about four times as many people, is only one-tenth of this area. Towns and settlements are separated by many miles of equatorial forest, and although roads, railways, and air transport are being steadily developed (since 1956 it has been possible to travel by rail, through this region, from the Indian Ocean to the Atlantic) the great Congo River and its tributaries are still the chief means of communication.

Belgium owes her colony to King Leopold II (1835–1909), for when Stanley returned from his great expedition to the basin of the Congo River in 1877 (see the end of the previous article), the Belgian king took the explorer under his patronage, seizing this vast territory as virtually his own private property and developing it with his private fortune. The Berlin Conference of 1884–85, which was a meeting of representatives of the European countries and the United States

A SHORE OF LAKE TANGANYIKA

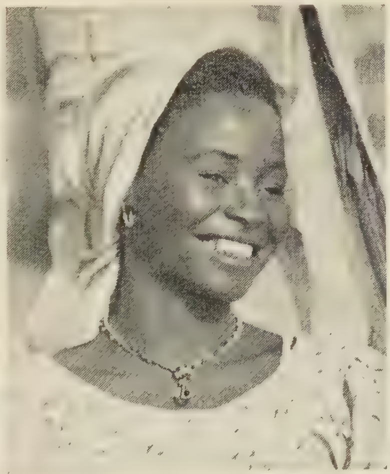
In this picture of the Usumbura-Urundi shore of Lake Tanganyika, Belgian Congo, waves like those of the open sea ride inland, bringing flotsam and jetsam from all parts of the inland sea. The beaches of this shore rise steeply to the foothills of the Urundi mountain range. African shore-dwellers net and spear fish.

A HILLSIDE QUININE PLANTATION

The lakes of the Belgian Congo lie deep in surrounding hills, and the shores are usually cultivated, as irrigation is comparatively simple. In this picture is seen a hillside rising from the shore of Lake Kivu. Rows of cinchona trees appear in terrace formation. From the bark of this tree is distilled the alkaloid quinine, a whitish-grey, crystalline, odourless substance with a bitter taste ; it is a tonic, and was for long the only really good remedy for malaria.

to discuss the division of Africa, recognized it as a sovereign state, with the proviso that the trade of all nations should enjoy complete freedom.

Leopold was obliged to concede parts of the Congo basin to France and Portugal. By 1890 financial difficulties had arisen and the king appealed to the Belgian parliament for a loan. It was granted with the condition that after 10 years Belgium should have the right to annex the Congo Free State, as it was called. Before that time expired many charges were made against Leopold. It was alleged that the natives were treated with barbarous harshness. A commission of inquiry was appointed which confirmed much of a report by Mr. (afterwards Sir) Roger Casement, the British consul, supporting these allegations. When in 1908 it became clear that the natives were still being oppressed, King Leopold sold the colony to Belgium, and it then became the Belgian Congo.



LOWER CONGO GIRL

A typical beauty from the coastal region of the Lower Congo. The ear ornaments and necklet are of local craftsmanship, but the dress reveals European influence.

Since those days the country has made great progress. Rubber was once the only resource developed. Now palm-oil, cotton, palm-nuts, and coffee are important exports. The mineral resources include copper, cobalt, diamonds, gold, radium, uranium, tin, zinc, and silver. The capital is the river port of Leopoldville. Boma and Matadi are seaports near the river mouth. A university, established in 1955, will have headquarters at Elisabethville and branches elsewhere in the country.

The districts of Ruanda and Urundi, formerly a part of German East Africa, are under U.N. trusteeship and are administered with the Belgian Congo. The area to the north and west of the river Congo, previously called the French Congo, was renamed French Equatorial Africa in 1910. It included four territories—Middle Congo, Gaboon, Ubangi-Chari, and Chad. In 1958, when the option of secession was offered, all four remained, some renamed, within the French Community. The total area of the region is about 969,000 square miles, and the population about 4,775,000, some 25,000 Europeans—an even larger and emptier land than the Belgian Congo. The Congo Republic, formerly Middle Congo (capital Brazzaville) is the most

TRANSPLANTING YOUNG CONIFERS

Valuable training in afforestation and tree conservation is given at the training schools of the Forestry Commission near Thetford, Norfolk. Here a student is seen transplanting three-year-old Douglas fir trees with the aid of a transplanting board which allows a row, regularly spaced, to be set at once. These trees are used for masts.

important area, lying immediately to the west of much of the course of the Congo and its tributary the Ubangi, and including the principal port, Pointe Noire. The capital of Gaboon is Libreville. The Central African Republic, formerly Ubangi-Chari (capital, Bangui) is near the densely forested heart of the African continent, but Chad (capital, Fort Lamy) is semi-desert in character, being on the verge of the Sahara. Trade is done in ivory, ebony, palm-oil, and mahogany.

Although the coast was explored by the Portuguese as early as 1471–75, three-and-a-half centuries passed before any permanent settlement was made. In 1839 the French Captain Bouet Willaumez made the first settlement, and ten years later Libreville was founded. First designed as a home for freed slaves, the colony was soon commercially developed. The credit for most of the exploration and development must be given to Count Savorgnan de Brazza (1852–1905), who after a decade of exploration became first commissioner-general in Gaboon. The colony was first farmed out to private companies, but their methods of exploitation caused such strong criticism in France that in 1911 their powers were considerably lessened. The same year large areas of Middle Congo and Gaboon were ceded to Germany in exchange for German recognition of French rights in Morocco, but were returned to France in 1920. In 1940 the colony declared for General de Gaulle against Pétain's French government, and from Fort Lamy, General Leclerc (1902–1947) made a spectacular cross-continental desert march in 1942–43 across southern Libya to meet the British Eighth Army.

Conifers. The trees of the pine and yew families, conifers, *i.e.* "cone bearers," together make up the botanical group *Coniferae*, a part of the great division of "naked-seeded" plants called Gymnosperms. Thousands of years ago there were more kinds of conifer than now, as can be discovered from the fossilised remains found in many parts of the world. Most of the present kinds are large evergreen trees forming forests in the cool temperate regions and on the mountains in hotter regions. In Australia, South America, the Himalayas, Japan, and China there are quite different conifers from those of Europe and North America, but many of them have been introduced into Britain, and some very interesting ones can be seen growing in Kew Gardens, London. They include yews, monkey-puzzles and the pine family, which is divided into true firs, Douglas firs, hemlocks, spruces, larches, cedars, pines, redwoods, wellingtonias, true cypresses, swamp cypresses, arbor-vitae, incense cedars, and junipers.

In size conifers vary from the small bush of dwarf juniper in northern Siberia to the "big trees," *Sequoia*, of N. America, about 300 ft. high, and the "big tree of Tule," *Taxodium*, nearly 56 feet across the trunk. In shape many are like "Christmas trees," particularly fir, spruce, and larch, but many pines have rounded tops. The leaves are needle-shaped in a great many conifers, but in cypress and others they are overlapping scales, in juniper there are both kinds, and in some foreign kinds they are fairly broad and flat. Larch and *Taxodium* shed all their leaves every year (*i.e.* are deciduous) but most other conifers shed only a few each year; the leaves last three to five years and the tree is then evergreen. In hot sunshine some of the resin in the tree evaporates from the leaves and has a characteristic scent.

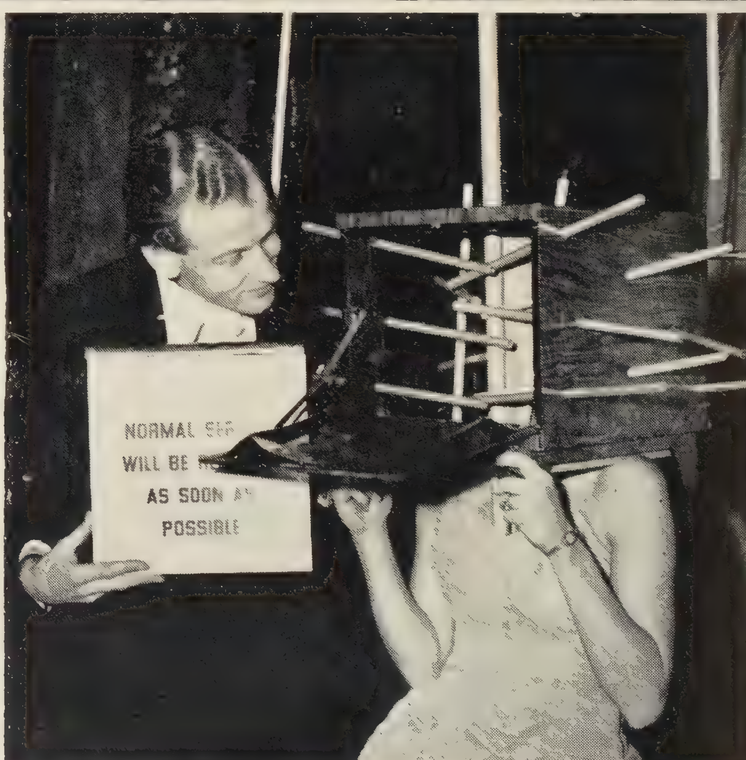
The "flowers" of conifers have no sepals or petals and no seed cases (ovaries). They are grouped into male cones containing stamens, and female cones containing tiny ovules, the future seeds. In the yew family the female cones are replaced by a kind of "berry," but the juicy scarlet cup always leaves the tip of the seed bare. Junipers have much harder, almost black "berries." The male cones of pine, cedar, fir, etc., are rather delicate, papery things which fall off as soon as they have shed their enormous clouds of pollen. Each pollen grain has two tiny balloons growing out of it, and the wind may blow it anywhere, but fortunately some grains usually lodge between the scales of the female cones and fertilise the ovules into seeds. In pine, fir, larch, and some other members of the pine family, the female cones when first seen are little pinkish knobs. On larch they appear a few days before the leaves. They grow much larger and stronger than male cones, and their spirally arranged scales become woody later. Pine cones take three years to develop and ripen their seeds, and a two-year-old cone looks green and shiny. Some cedars have

CONIFERS AND THEIR SEED-CARRYING CONES

Though both are conifers, the Scots pine, 1, and the Douglas fir, 2, are quite unlike in appearance. So also are their cones: Douglas fir at number 3, Scots pine (shown with the scales parting to liberate the seeds) at number 4. A cone of the Wellingtonia redwood is shown at 5; larch at 6; Monterey cypress at 7; Norway spruce at 8. Cones are generally dark brown and hard and woody when mature. These are not drawn to scale.

QUICKNESS OF THE HAND DECEIVES THE EYE

At a children's Christmas party or at any gathering of youngsters the conjurer is always welcome, whether producing rabbits out of an "empty" silk hat, juggling with billiards balls, or making a woman's head vanish within the casing of a television set.



cones of a greyish colour with green and purplish "bloom" like the colours on a wood-pigeon's breast, but most other cones are brown when ripe. The seeds form in pairs and have a flat, papery wing to whirl away in the wind, but sometimes squirrels will take a whole cone and gnaw away the scales to get at the seeds, leaving only the middle stalk. Some birds, especially the crossbill, eat pine seeds, and the Mediterranean stone pine has large seeds which are used for human food. Most of the conifers produce valuable timber which does not rot as easily as deciduous-tree timber. They also provide resin, from which turpentine, tar, and pitch can be made.

People who are not interested in trees often call almost any conifer a fir tree, or perhaps a pine, but the common types are not very difficult to tell. Yews are known by their very dark green leaves and by the scarlet "berries" on the female tree. Monkey puzzles are unmistakable with their overlapping scale-like leaves thickly clothing every branch almost like a giant cactus. On silver firs the leaves are short, flattened, and silvery on the undersides; the trees taper to a point and bear upright cones placed like candles on a Christmas tree. The Douglas fir is a similar tree, but its cones hang downwards and the leaves are much less stiff. Spruces (sometimes called spruce firs) are very tapering trees, but their leaves are stiff and four-sided and each grows out of a small lump on the twig. The cones hang downward. Larches are very delicately shaped, with drooping tips to their branches, dainty small cones, and (most unusual for conifers) leaves which all fall in autumn. The true cedars taper to a point only when young. Later they develop spreading horizontal branches with flat masses of needle-leaves, slender upright male catkins, and smooth barrel-shaped female cones. Pines bear needle-leaves in groups of 2–5. The cones hang down when ripe and are much more knobbly than in most other conifers. The full-grown trees are never pointed at the top, but flattened or umbrella-shaped. The huge redwoods and wellingtonias have small scaly leaves and much smaller cones than most pines, while cypresses have very tiny, closely packed scales for leaves, and cones usually smaller than cherries, with only a few cone-scales. Junipers are usually only shrubs, the British one being rather like gorse, though without the yellow flowers of gorse. The rather tough "berries" turn purplish black as they ripen. (See also articles on the individual trees.)

Conjunction. A conjunction is a "joining together" word. There are very few of them in the English language, but they are exceedingly useful words and save a great deal of time. Suppose one wants to say that John, Frank, and Mary each has a chocolate. If there were no conjunctions this statement could not be made clear without saying "John has a chocolate, Frank has a chocolate, Mary has a chocolate." But by the use of the word "and," which is a conjunction, all this repetition is avoided, and a single statement conveys the meaning clearly.

Conjunctions get their name from a Latin word, *conjunctio*, meaning joining together. They may connect single words or entire phrases, clauses, and sentences. Those that connect elements of the same grammatical value or rank are called co-ordinate conjunctions. Those that connect clauses of different grammatical ranks are called subordinate conjunctions; many of these are adverbs used as conjunctions, and so are also called conjunctive adverbs. (*See* Adverb.)

Besides merely connecting, conjunctions are used to express various relationships. Co-ordinate conjunctions may denote addition (also, and, moreover); separation or choice (either, or, neither, whether); opposition (but, however, whereas, yet); result or effect (so, therefore, thus, hence). Subordinate conjunctions may denote time (when, after, while); place (where, whence); cause (because, for, as); condition or supposition (if, though, unless); purpose or result (lest, that, in order that); comparison (than, so, as).

Many conjunctions are used in pairs, for example: either—or; though—yet; not only—but also. These are called correlative conjunctions.

Conjuring. The art of mystifying people is very old indeed. The first conjurers were priests, who obtained power over simple minds by performing magical tricks which appeared to have a supernatural origin. The Old Testament contains many examples of priestly "miracles" which may have had a natural explanation. Elijah's victory over the priests of Baal on Mount Carmel, possibly through his knowledge of a local deposit of naphtha, and Elisha's raising of the dead child by what may well have been artificial respiration, are two well-known examples. The old priests had some knowledge of the weather and the stars, which enabled them to foretell rainfall, eclipses, and other natural happenings; and of simple chemistry, which made possible "miracles" like turning water into "blood." The witch doctors of primitive Africa to-day maintain their hold on the minds of their simple followers by similar tricks, styled "white magic" as distinguished from sorcery or "black magic."

The ancient Greeks, listening in awe to the voice of an oracle booming out from some holy cavern, were the willing dupes of priestly knowledge of acoustics (behaviour of sound), in the same way as the audiences of the 1840s, who gazed in amazement at the German conjurer Döbler's trick of lighting 200 candles by firing a pistol, were deceived by his knowledge of electricity. The favourite parlour trick of changing the colour of water as it is poured from one glass to another depends on the presence of crystals of a different chemical compound in each glass; in other words, it relies on the conjurer's knowledge, and his audience's ignorance, of a simple scientific fact. Everyone knows that a pin can be made to jump a few inches into the air if a magnet is held over it; but in the theatre the audience forgets that a very powerful electro-magnet above the stage can similarly cause "levitation," or the apparent floating of objects in the air.

One of the most famous of modern conjurers, Robert Houdin (1805–71), based many of his successful illusions at his Paris Theatre of Magic, opened in 1845, on the then little-known powers of electricity. He was at one time a "witch-doctor" in Africa, for in 1856 the French government sent him to Algiers for the political purpose of impressing the Arab chiefs with his tricks. Like

John Nevil Maskelyne (1839–1917), Houdin specialised in making automata—mechanical figures which behave like human beings—a form of conjuring that anticipated the "electronic brain" used to-day to work out mathematical problems (*see* CALCULATING MACHINE). Both Maskelyne and Harry Houdini (1873–1926), the American "escapologist," devoted much energy to exposing the trickery of fraudulent spiritualist mediums, much of whose power over people all too ready to believe is based on scientific knowledge that is not shared by their audiences.

The other kind of conjuring trick, more popular and frequent to-day, depends not so much on scientific knowledge as upon ingeniously contrived mechanisms and on the performer's legerdemain, prestidigitation, or quickness of hand. From the simple egg-in-bag trick, obtainable at a toy-shop for a few pence, to the elaborate machinery, trap-doors, and stage management of the modern illusionist, this type of conjuring is completely baffling to those who are "not in the know." But it, too, goes back to antiquity: the Chinese and Japanese of long-past ages constructed many beautiful "disappearing" bird-cages, goldfish-bowls, and so on, and skilled craftsmen throughout history have been engaged in making illusionist material. Before they became professionals, Houdin was a maker of mechanical toys, Maskelyne was apprenticed to a watchmaker, and Houdini was a locksmith. Maskelyne and Devant's stage machinery at the Egyptian Hall, London, and from 1905 to 1933 at St. George's Hall, Regent Street, was fantastically elaborate. Almost the whole stage was a network of trap-doors and rising platforms, and behind the black velvet curtains which masked many a secret "disappearance" was an elaborate, silent-running conglomeration of lifts and tackles, electric elevators, and other machinery, as well as a small army of perfectly trained stage-hands.

This type of trick is often the copyright of its owner, and little knowledge of "how it is done" is permitted to leak out. The Magic Circle, a club of professional and amateur illusionists, allows quite a large number of simple tricks to be sold to the public, but keeps secret the most mystifying. Thus, though many profess to know how a woman is "sawn in half," none can say for certain that the victim is really two women curled up in the two partitions of a long box, the head and neck of one and the feet and legs of the other being visible to the audience. Nor should we seek to pry too closely into the mysteries of stage magic. The joy lies in being amazed, and if everyone knew "how it was done" the ancient and honourable profession of conjurer would come to an end and with it much of the little romance and wonder that is left in the prosaic modern world.

Connecticut (pron. konet′ikut). This state, one of the original 13 of the United States, is situated on the Atlantic seaboard and has an area of 5,009 square miles. It is bounded on the west by New York State, on the south by Long Island Sound, on the north by Massachusetts, and on the east by Rhode Island and the Atlantic. It is one of the leading industrial states (although the third smallest), but in the east and west dairy farming is still carried on. The most valuable crop is tobacco, the mild-flavoured leaf being used to wrap cigars. More than half the area of the state is covered by extensive forests.

Among the chief products are brass and bronze articles, hardware, ammunition, clocks, watches, all types of machinery, and clothing. Hartford, with a population of 177,397, is the capital and largest city, and remains the chief American centre of the insurance business. At New Haven is the famous Yale University (founded in 1701). The population of the state in 1950 was 2,007,280.

Connecticut, which was originally settled by migrants from the colonies of Massachusetts Bay, as well as from England, has retained something of its Puritan character. Its harsh climate and stony soil, as in other New England states, has made life difficult for the farmer, and forced Connecticut Yankees to make a livelihood at sea, fishing, and trading with distant continents from little ports like New London and Essex. In the last hundred years much of the trade of these small places has been diverted to New York, and the southern part of the state is now linked to the great metropolis. It grows "truck" crops—market-garden produce—to feed city dwellers, for whom also villages of old white-framed houses have been turned into week-end homes. The descendants of the early settlers have been hemmed in, not only by New Yorkers moving north, but also by new generations of Irish, Polish, and Italian immigrants who now provide the bulk of the labouring populations of cities like Bridgeport and New Haven.

Conrad, JOSEPH (1857–1924). If you imagine a Pole, born in a country that had in his day no seaboard, becoming a supreme master of a difficult foreign language—English—and writing in it superbly about that most English of subjects —the sea—then you have a thumbnail sketch of Teodor Josef Konrad Korzeniowski: known as Joseph Conrad from the date of his naturalisation as a British subject in 1886.

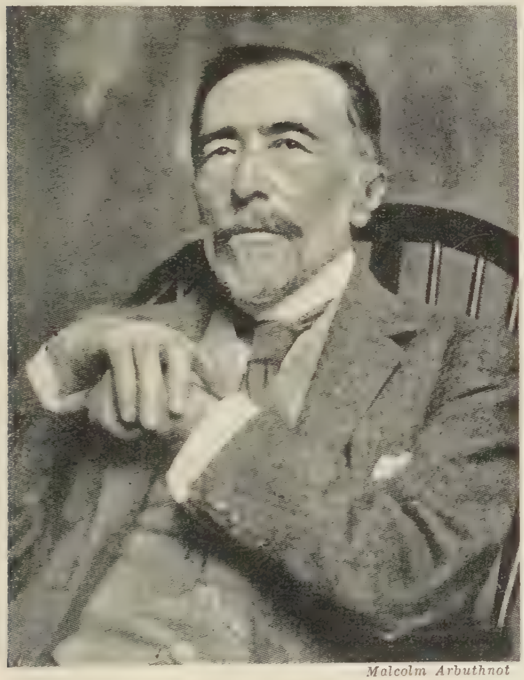
Born near Mogilev, then part of a Ukraine ruled by Russia, he was the son of a Polish landowner and literary man who had translated Shakespeare into Polish. Josef lost his father when he was 12, was looked after by his uncle, and by the time he was 15 had begun to badger his guardian to let him go to sea. In 1874 the uncle gave in, and by December of that year Josef had arrived at Marseilles and shipped aboard a vessel of the French mercantile marine. He had learned good French from his father, who was expert in the language, and he sailed in French ships until 1878, when he transferred to the British merchant marine, in which he was to remain for the rest of his seafaring career. In 1886 he took British nationality, and in the same year won his master's ticket.

Thenceforward Conrad led the life of a skilful, hard-working, hard-bitten master mariner, mostly in the Orient, and became soaked in the colour and atmosphere of the Malay Archipelago, which he was later to use to such good effect in his novels. His first novel, *Almayer's Folly*, was begun in 1889, and was worked upon at odd moments for some four years on his travels. It came out in 1895, by which time Conrad had decided to give up the sea for literature. Early books like *The Nigger of the "Narcissus"* (1897), *Lord Jim* (1900), *Typhoon* (1903), and *Nostromo* (1904) won welcome from a

few good judges, but were very far from enjoying any outstanding success.

For 18 years Conrad struggled bitterly on, working hard, earning little, fighting ill-health and comparative poverty, with a wife and two sons to maintain. In 1914, when he was 56, material success came with a rush. *Chance*, which had appeared in London in 1913, was enthusiastically received in America, and Conrad became both wealthy and famous.

Not all Conrad's novels dealt with the sea. There were others, like *The Secret Agent* (1907), which harked back to the Russian scenes of his youth. Others again, like *The Arrow of Gold* (1919) and a short story *Gaspar Ruiz* (published with *Youth* in 1902), had a Spanish background. And even the sea stories, despite the deep and intimate knowledge they display of seamanship in all its aspects, are fundamentally studies of human character,



Malcolm Arbuthnot

JOSEPH CONRAD

A master of English literary style, who for thirty years delighted readers with his stories of the sea, the ways of mariners, planters and others, and the fascination of life in lands hitherto unknown to many of his admirers.

very deeply and subtly portrayed. In some of his books he used a remarkable (not to say bewildering) literary technique of the "story within a story," describing the background of a given character, who then tells the main story.

With his neat, clipped beard and curiously-set eyes, Conrad looked what he was—a Slav. And despite his profound knowledge of English he never learnt to speak it without a strong accent. The old story, that before writing his books he hesitated whether to write in English or French, was denied by Conrad himself. He had a remarkable mastery of both tongues, but in English he wrote such magnificent prose that he is accepted among the masters.

Conservatives. At one time there were only two great political parties in Great Britain, the Conservative and the Liberal.

When Sir W. S. Gilbert was writing his witty rhymes for the Gilbert and Sullivan operettas, he was able to say

> That every boy and every gal,
> That's born into the world alive,
> Is either a little Liber-al,
> Or else a little Conservat-ive!

The names Conservative and Liberal date only from the 19th century, but the parties are descended from the earlier Tories and Whigs. These names were originally insults flung at each other by men of opposite views in the reign of Charles II. In 1679-80 many people wished to exclude the Roman Catholic Duke of York (afterwards James II) from succession to the throne. They sent petitions to the king urging him to summon parliament to pass a bill for this purpose, and were therefore called Petitioners, or Whigs. Their opponents, in loyal addresses to the king, expressed abhorrence of these petitions, and were called Abhorrers, or Tories. Whig was probably an abbreviation of Whiggamore, a nickname for the Scottish Covenanters, and Tories were Irish freebooters, but by the next century the names had ceased to be terms of reproach. The title of Conservative first came into use from about 1830. In 1886, with the opposition to Gladstone's Home Rule bill for Ireland, the title Unionist arose, and the full name is still Conservative and Unionist party.

Just as in Charles II's day the Tories were sticklers for legality, so ever since they have been foremost in support of the established institutions of the country, though they are also in favour of necessary reforms, and have carried out notable legislation in such matters as factory employment and public health. They have been what is called Church and King men, and they are popularly identified with the defence of private enterprise as opposed to the nationalisation of industry. They are also particularly interested in the maintenance of close commercial ties between members of the British Commonwealth of Nations.

In general terms, one big issue on which Conservatives and Liberals traditionally took opposite sides was that of freedom of trade. A Liberal is usually a "free trader," and a Conservative usually believes in "protection," which means levying duties on foreign products so that foreigners shall not, by paying sweated labour rates, rob British workmen of their jobs.

Modern Conservative thinking was well summed up in a speech by Mr. (later Sir) David Eccles, M.P., in 1951. He identified Conservatives of to-day as "the active producers of wealth. The skilled workers with hand or brain. Those who manage or dream they will one day manage a factory, a shop, or a farm." Conservatives believe that fair competition is a good thing in itself, spurring everyone on to his best effort. They are, in general, against nationalisation, which seems to them wasteful, inefficient, and productive of over-high taxation. Their contemporary ideal is "a property-owning democracy," and includes a standard minimum wage for all.

ONE OF CONSTABLE'S FAMOUS LANDSCAPES

Much of the beauty of John Constable's paintings is due to his ability to create atmosphere, and this he achieved by study of the sky in all its moods and at all seasons. This beautifully composed landscape, which he called "The Hay Wain," has all the somnolent heaviness of an evening in high summer, when the long day's labour in the hay-field is ended and the farmer is free to water his horses in peace. The picture now hangs in the National Gallery, London.

Among leading Tory and Conservative statesmen were William Pitt the Younger, the Duke of Wellington, Sir Robert Peel, Benjamin Disraeli (Lord Beaconsfield), Arthur James Balfour, Austen and Neville Chamberlain, and Stanley Baldwin. Famous political leaders who ended as Tories after spending years in the opposing camp are Edmund Burke, Joseph Chamberlain, and Sir Winston Churchill.

Constable, John (1776-1837). It has been said that this great English painter of landscapes was the first artist to discover that trees were green. What this really means is that in the days when Constable began to paint, it was the fashion to represent trees and fields in pictures in a dull brown colour, which was considered more harmonious and therefore more beautiful than green. Constable had no use for such a notion.

This was not the only difference between Constable and the lesser landscape painters of his time. The painting of landscape was not then considered a very dignified form of art, unless simple scenes were rearranged according to a certain formula—so much light, so much dark—and so romanticised as to look more like pictures of imaginary scenery than like the real thing. Also, the grandeur and majesty of foreign scenery appealed so much to these painters that they missed all the beauty of the familiar countryside around them. But Constable loved the scenery at his very doors, and was content to depict the English scene, with its changing beauties of cloud and sky, river, woodland, and the homely, unpretentious buildings around him. He derived all his inspiration from studying nature for himself and representing it without paying the least regard to the style of painting then fashionable.

So it was a long time before he received the recognition that he deserved. Most of the critics derided his pictures at first. When he tried to reproduce the effect of shimmering light on trees and distant valleys, they talked contemptuously of "Constable's snow." And, of course, they thought his use of green to be vulgar and "showy." Even after his death, when his pictures were put up to auction, they realized only very meagre prices.

But in 1824 three of his landscapes which he sent for exhibition to the Paris Salon were so much admired there that he was awarded a gold medal; and these pictures had a great influence on the later development of French landscape painting.

Constable was born at East Bergholt, Suffolk. His father, a prosperous miller, hoped he would enter the Church, but when John showed he had no aptitude for bookish study his father tried to make a miller of him, so that he could eventually take over the business. Towards the son's artistic ambitions the father showed no sympathy, until, when John was 23 and had attracted the interest of a well-known art connoisseur, Sir George Beaumont, he was allowed to become a student at the Royal Academy.

Although he always had a number of admirers, loyal friends, and generous patrons during his lifetime, it was only about fifty years after his death that his own countrymen in general began to realize what a great painter he was. Many of his masterpieces are now among the nation's most treasured possessions. A picture of "Stratford Mill," which he painted in 1820 and which was

purchased for the nation in 1946, was called by Sir Alfred Munnings, then President of the Royal Academy, "the greatest landscape ever painted." High praise indeed! Other delightful pictures in the national collections include "Salisbury Cathedral from the Meadows," "The Hay Wain," "Dedham Vale," "Flatford Mill," "The Valley Farm," and "The Leaping Horse"; and the Victoria and Albert Museum, South Kensington, possesses a series of brilliant preliminary sketches, swiftly painted direct from nature, some in oils, some in water-colours, which many admirers even prefer to his large finished pictures.

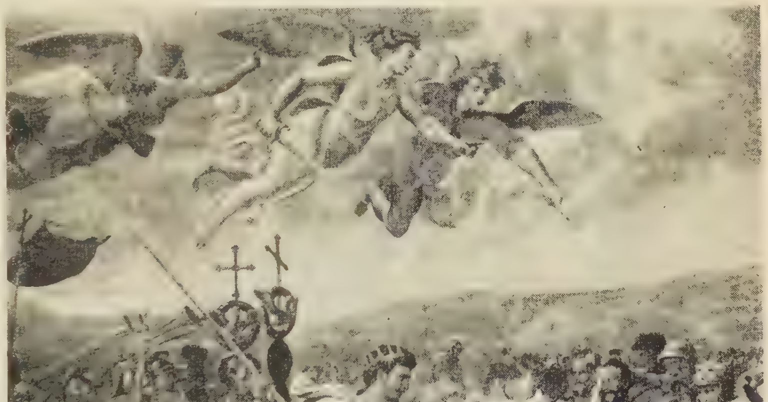
The neighbourhood of Dedham, in Essex, and Flatford, in Suffolk, provided him with so many subjects for his brush that you will often hear people speak of it as "Constable's country."

Constantine (*c.* 280–337). Known in history as Constantine the Great, also as the Christian Augustus, Flavius Valerius Aurelius Constantinus was born at Nish, in what is now Yugoslavia, about A.D. 274. Educated at the court of Galerius, the Eastern Roman emperor, he succeeded his father, Constantinus Chlorus, in 306. His troops at Eboracum (York) in Britain proclaimed him Caesar in 306. In 308 the army raised him to the dignity of Augustus (supreme and benevolent ruler), and he was thereafter known as Flavius Valerius Constantinus Augustus.

At the time he came to the throne the Roman empire was governed by four rulers under an arrangement made by Diocletian in A.D. 293. Constantine discovered that this system did not work well and decided that it would be best for the empire to have only one ruler—himself. His mother had long been a Christian, and Constantine was won over to Christianity by two visions which preceded his attack on Maxentius, who was holding Rome. In the first he saw a fiery cross, underneath which were the words *In hoc signo vinces* (in this sign thou shalt conquer). The second was in a dream as he prepared to assault the walls of Rome; he was told to have the Christian monogram  (*Jesus, hominum salvator*) put on the shields of his soldiers. This he did, and Rome fell to his troops.

From this time forward, persecution of the Christians stopped. In 313 he issued the Edict of Milan, which gave Christians the right to practise their religion openly; in 325 he called together at Nicaea the first general Church council to discuss and settle a certain long-disputed controversy over Church doctrine. At this council the beliefs of the Church were set down in the form called the Nicene creed. In 323 the last of the independent rulers of the Roman empire was defeated and Constantine was ruler of the whole empire. He changed the capital from Rome to the ancient city of Byzantium, on the shores of the Bosporus. He enlarged the city and renamed it Constantinople (the city of Constantine). The closing years of Constantine's life were peaceful; many churches and palaces were built and great festivals delighted the people. (*See* CHRISTIANITY.)

Constellation. The early history of the constellations is unknown, and for a long time it was thought that the Greeks were the first people to map the stars into groups and give names to the figures thus formed. But writings of the period 3000–500 B.C. have been found in the Euphrates valley, proving that similar constella-



Anderson; Brogi

CONSTANTINE VICTORIOUS AT MILVIAN BRIDGE

Constantine the Great became a Christian as the result of visions he had seen promising him victory over his rival Maxentius if he embraced the new faith. This painting, by the Italian artist Giulio Romano (*c.* 1492–1549), shows Constantine at the battle of Milvian Bridge (312), by the Tiber, in which Maxentius was defeated after Constantine had adopted the Christian emblem.

STAR-GROUPS YOU CAN SEE IN THE WINTER SKY

It is probable that the Chaldeans, who lived in the Euphrates valley in what is now Iraq, grouped the stars into constellations in connexion with their religion. The Greeks gave these fancied star-patterns the names of gods and goddesses, of ancient heroes and heroines, of beasts and birds, and astronomers still use the early names. The picture shows a portion of the sky over Great Britain at midnight on January 1; the outlines of the constellations have been filled in. You must imagine you are facing south and looking up directly over your head. The Dipper (top left) is also known in Great Britain as the Plough.

tions were important in religion and in mythology even at that early date, and probably long before. It is likely that the Greeks first took over these shapes in the heavens from the Phoenicians, and they from the Chaldeans, who lived in the Euphrates valley.

The Greeks, with their vivid imaginations, elaborated this idea, and the constellations took on the shapes of gods and goddesses, of ancient heroes and heroines, of beasts and birds—all playing their parts in a great heavenly drama.

On dark nights, perhaps while guarding the sheepfold from the wolves, the Greek father taught his son the names of the constellations and their positions. There was, for instance, the story of the Great Bear, who was really the beautiful nymph Callisto. This nymph had aroused the jealousy of Hera, wife of the great god Zeus. To protect Callisto, Zeus changed her into a bear. But Arcas, Callisto's son, while hunting in the forest, was about to kill his mother, whom he took for an ordinary bear, when Zeus in pity changed him into a little bear, and placed them both in the heavens. There they are to this day, the Little Bear (Ursa Minor), the tip of whose tail is the North (or Pole) Star, and the Great Bear (Ursa Major), whose tail and saddle form the group known as the Plough, because the stars form that shape.

And so each one had a story. Hercules (Heracles) is swinging his club, while Ophiuchus holds the Serpent. The Swan and the winged horse Pegasus are flying an eternal race. Andromeda is struggling in her chains, while Perseus, carrying the head of the Medusa he has just slain, rushes to her rescue. Castor and Pollux, the "heavenly twins," and a score of other figures take their part in the great panorama of the night sky.

Most easily recognized of all the star groups is the Plough, previously mentioned. The body of the implement is made up of four stars at the four corners, while three other stars give the outlines of the bent handle. If you learn to know the Plough you can always find the North Star, for it is the first bright spot in a line with the two stars which form the side of the Plough opposite the handle. The Plough is also known as Charles's Wain (meaning the farmer's, or "churl's," waggon) and, in the United States of America, as the Dipper.

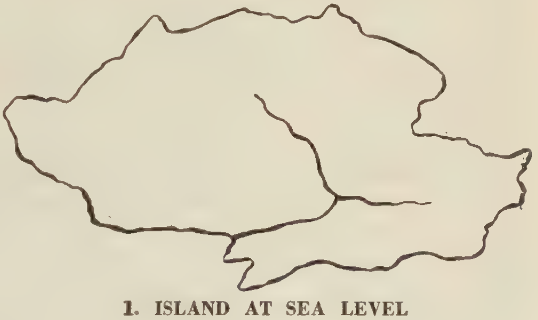
There are, of course, many constellations visible to people who live on the southern half of the earth that cannot be seen in northern latitudes. These were unknown to Greeks, and received their names in later times. Among them is the Southern Cross, so frequently mentioned in tales of sea voyages south of the equator.

Hipparchus (? 160–125 B.C.), a Greek astronomer, determined the positions of the classical constellations and enumerated them in 48 figures. About 300 years later Ptolemy, a great Egyptian astronomer, made a few alterations in the constellations of Hipparchus, but also listed 48 groups. For some centuries Ptolemy's list was left undisturbed, until in 1601 Tycho Brahe, the eminent Danish astronomer, added two constellations, and then for 200 years every famous astronomer felt bound to name a new group of stars. Thus by 1800 there were 109 fairly well-known constellations. Some of these overlapped, and in 1928, by common consent, the number was reduced to 88. Important constellations, besides those already named, are Cassiopeia (the Woman in the Chair), Lyra (the Harp), Scorpio (the Scorpion), Corona Borealis (the Northern Crown), Leo (the Lion), and Auriga (the Charioteer). (*See also* ASTRONOMY; STARS; ZODIAC.)

Contours. The article on MAPS, in a later volume of this work, shows the various ways in which map-makers tackle the problem of representing the curved surface of the earth on a flat sheet of paper. But as well as being curved, the earth is full of bumps and hollows—mountains and valleys, plains and plateaux—and indicating the relief, as it is called, is another problem for the map-maker. In the 16th and 17th centuries two famous map-makers, Christopher Saxton and John Speed, made maps of the counties of England with the hills drawn in. These look very attractive, and people still use copies of them to decorate their walls, but by modern standards they are not accurate, and pictorial maps of this kind cannot show much detail. There are more practical ways of making relief maps, and the method most used is contouring.

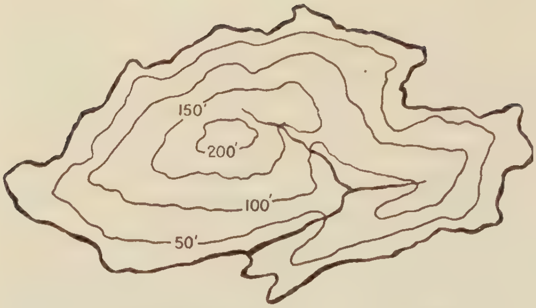
A contour is a line joining all points at the same level. Thus the coastline drawn on a map is a contour, every point on it being at sea level. In the same way a line can be drawn to join every point at a height of, say, 50 feet, and another line for points at 100 feet, and so on. Diagrams 1, 2, and 3 show an island mapped in this way.

The difference in height between two contours is called the vertical interval. In a map of a large and mountainous area this vertical interval may be as much as 3,000 feet. Look, for instance, at a relief map of Asia in the atlas. Here an inch represents hundreds of miles, and in that small space the surface has to be shown as rising from sea level to the great heights of the Himalayas. Now by contrast look at an Ordnance Survey map

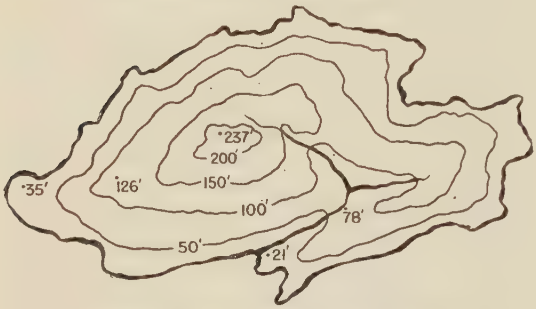


1. ISLAND AT SEA LEVEL

2. SAME ISLAND WITH 50′ CONTOUR



3. CONTOUR MAP OF THE ISLAND



4. RELIEF SHOWN BY SPOT HEIGHTS

with a scale of one inch to one mile. For these maps the vertical interval between contours is usually 50 feet, and this gives a very detailed picture of the country. For example, if the contour lines come close together on one side of a range of hills and are well spaced out on the other, it is immediately clear that one side has a steep slope, the other a gentle one. Much delight can be had from studying such a map, especially in planning walking or cycling tours.

Contours do not, of course, give fully accurate information about any point on a map. All that can be gathered from them is that the land between them is within a certain height—between, say, 50 and 100 feet, or between 6,000 and 9,000 feet. The exact heights are sometimes added at precise spots, such as the tops of hills, or places of importance (see diagram 4).

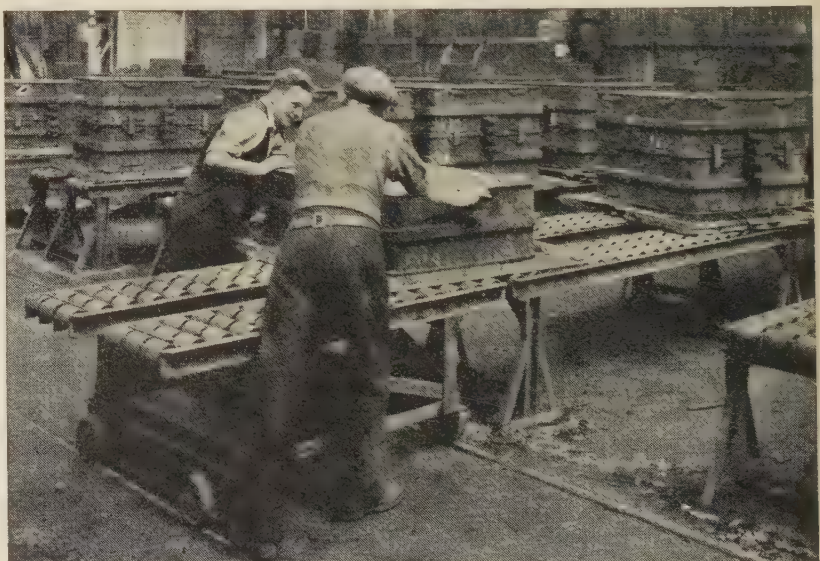
Submarine contours (that is, contours of the sea bed) can be shown in the same way as land contours. Often colour is added to show the variations of height and depth. Shading through green and yellow to brown (with white for highest mountains) is popular for land, and shades of blue for water.

Conveyors. Picking things up and putting them down again takes up more time and costs more money than anything else in industry. To move an article about from department to department in a factory often costs more than the actual manufacturing processes. To reduce handling costs and to save time, engineers have designed ingenious machines called conveyors to replace human hands in handling.

Conveyors are as varied in their shapes and methods of working as are the types of goods they handle. They can be built to carry all kinds of articles, whether they be molten metal, lumps of coal or stone, flour or other powdered material, bottles, boxes, or parts of aeroplanes or motor-cars, and to move goods between several floors of a building as well as on the same level.

One of the simplest mechanical conveyors consists of a long, narrow steel frame on which are mounted steel rollers turning on ball bearings (*see* BEARINGS). One end is slightly higher than the other, so that anything placed on the roller travels by gravity—*i.e.* the pull of the earth.

This type of conveyor cannot be used to carry goods from a lower to a higher level. For that purpose the conveyor consists of a long rubber belt or slats of metal supported on rollers throughout its length. The rubber belt or chain of metal is made on a continuous piece like a huge loop, so that its total length is double the distance that the article has to be conveyed. One end passes over a steel spindle driven by an electric motor, and the other end passes over another spindle, called an idler, which is not driven by a motor. As the motor-driven spindle turns, it pulls the belt forward, so that on the carrying part of the journey the conveyor is on top of the framework, and then turns over on the spindle and travels back underneath to the starting point.



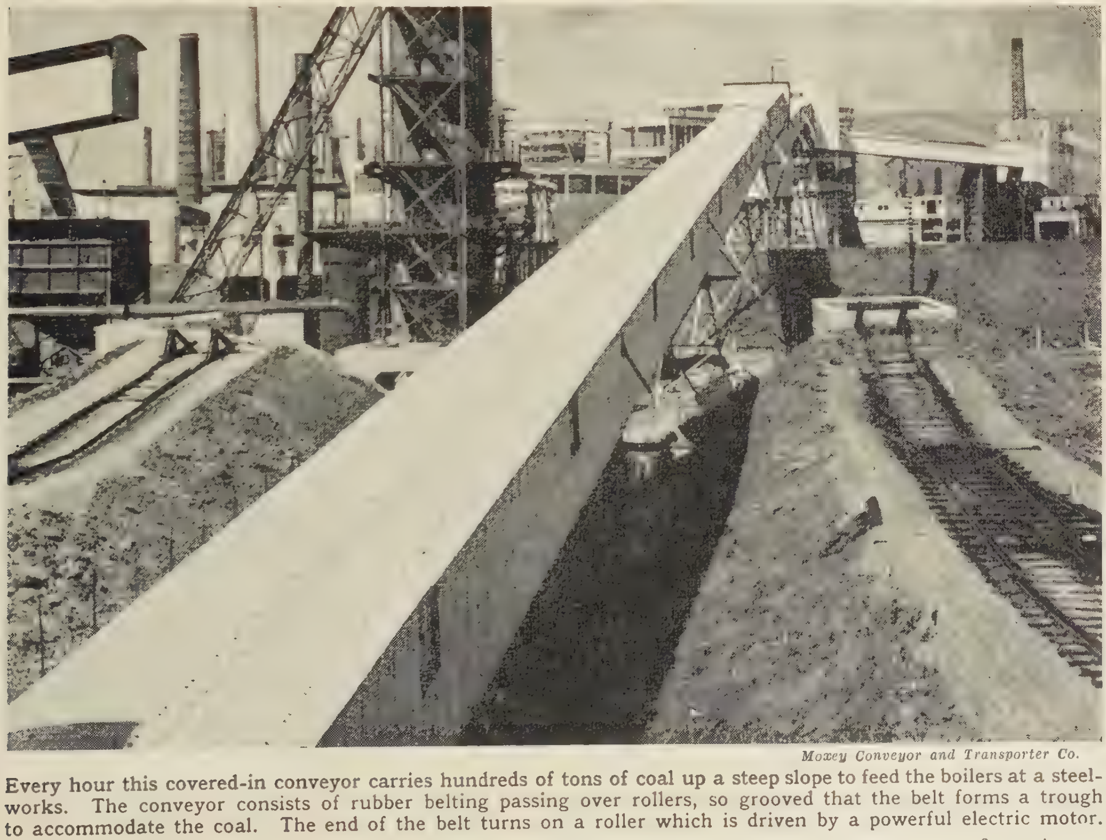
J. Collis & Sons, Ltd.

ROLLING HUNDREDS OF TONS

It would be very hard work indeed to lift and push these heavy moulding boxes by hand. But with a truck on rails and ball-bearing roller conveyors these two men can move hundreds of tons for long distances in an hour without undue fatigue. The funnels on top of the boxes are for pouring molten metal into the moulds.

Cadbury Bros

The simplest conveyors to operate and the cheapest to build work by gravity, like this one carrying tins in a cocoa factory. These strips of steel forming a long cage are suspended from the roof by light girders and so arranged that one end is higher than the other. As the slope would be too steep if the cage was given a straight run, the strips are bent over on the right. This acts as a brake on the procession of tins, preventing their rolling too quickly.



Moxey Conveyor and Transporter Co.

Every hour this covered-in conveyor carries hundreds of tons of coal up a steep slope to feed the boilers at a steelworks. The conveyor consists of rubber belting passing over rollers, so grooved that the belt forms a trough to accommodate the coal. The end of the belt turns on a roller which is driven by a powerful electric motor.

When goods have to turn corners, two conveyors are used, placed at right angles, like a capital L. As the articles on the first conveyor reach the end of the carrier, a metal arm automatically pushes them on to the second.

There are two methods of conveying goods from one floor to another. In one an ordinary belt or slat conveyor carries the articles part of the distance and then transfers them to the lifting conveyor which has ridges to stop articles from sliding backwards. In the alternative method the lifting conveyor consists of two endless chains to which are fitted a number of flat platforms. As each article on the level conveyor reaches the end of the belt, it slides on to a platform and is thus raised to the higher level.

Conveyors used for carrying loose material, such as lumps of coal or pieces of stone, have rubber or metal mesh belts carried on two sets of rollers which slope towards each other so that the belt sags down its length to form a long moving trough. If the material has to be raised to another height, it falls from the trough on to an endless chain carrying brackets which lift it up.

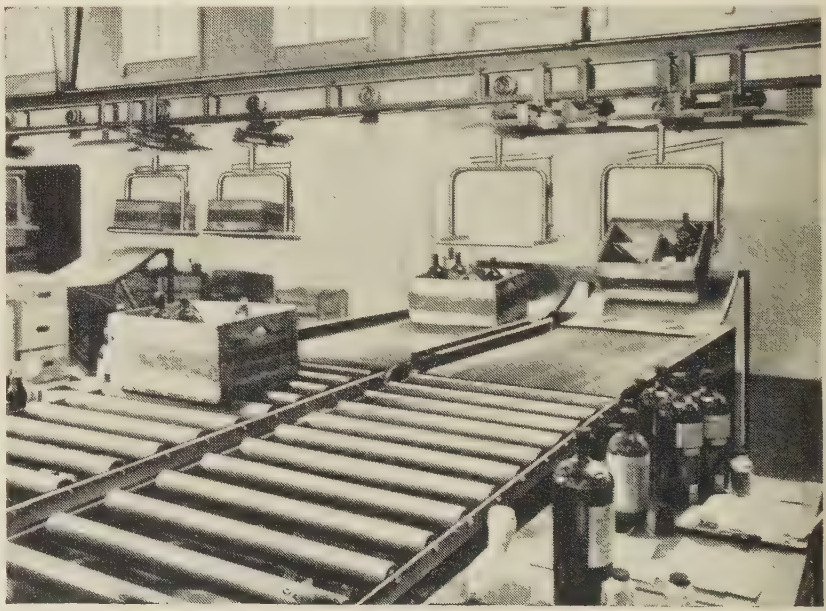
Powdery material like flour or sand is sometimes conveyed through a stationary metal trough in which turns a long spindle with projections very like the threads or worm of a screw. As the spindle turns, the projections or worms push the material forward along the length of the trough.

Factories making articles by the assembling or putting together of many different parts use special types of conveyor which are timed to run at the exact speed needed for each worker to do his or her particular assembling job before another part arrives. Some of these conveyors are fitted with a device operated by a photo-electric cell, which automatically takes away any imperfect article.

Other types of conveyor consist of a single rail, suspended from the roof of the factory buildings, which winds from one workshop to another and rises from floor to floor. Running on the rail are small trolleys from which hooks are suspended and to which are attached the articles to be carried. The trolleys are pulled along the rail by a chain. Some types can carry goods automatically to any one of a hundred or more different parts of a factory by the flicking of a simple key on each trolley. Other versions, controlled by an "electronic brain," can feed components into machines, take them out when the operation is completed, and pass them on through later processes, all without being touched by hand.

It was in the mass production of motor-cars that the use of conveyors was first highly developed. From beginning to end, the cars and their parts pass by conveyor to the different departments where mechanics put them together. The conveyor runs at the exact speed necessary to allow each workman to do his particular job (worked out by time-and-motion engineers). At certain points on the route the cars are conveyed through paint-spraying rooms and drying rooms, and finally past a pump that fills them with petrol, so that they can be driven straight on to the roads. (*See* CANNING picture opposite page 223 for the use of conveyors in that trade.)

Convolvulus. In bud, the petal trumpet of a convolvulus flower is twisted like a rolled-up umbrella, or "convoluted." Either this or the twining of the stems probably gave the plant its name (Latin *convolvo*—I entwine). There are many kinds of wild convolvulus, especially in the Mediterranean regions. A few, including the greenhouse climber known as morning glory, are tropical; and three grow in Britain. They are nearly all climbing plants with non-woody stems and trumpet-shaped flowers. The lesser bindweed, *Convolvulus arvensis*, is common in English fields, where it either creeps over the ground or twines round other plants. As a weed it is difficult to remove because of long creeping underground stems and roots which are very deep. The leaves are shaped like spear-heads and the pink flowers are almond-scented. The greater convolvulus, or white bindweed, *Calystegia sepium*, climbs over hedges. Its large white flowers have two baggy leaves hiding the calyx, and are unscented. They stay open on moonlight nights but, like those of their smaller relative, close in wet weather. The beautiful convolvulus hawk moth visits them for honey. Sea



Sovex, Ltd.

AUTOMATIC UNLOADING BY CONVEYOR

Each of the trays on the overhead conveyor is fitted with a set of "destination keys," numbered to correspond with delivery points. When loading the trays, the operator presses the appropriate key, and the conveyor mechanically makes its "selection," and automatically discharges the load on arrival at the correct destination

H. Bastin

CONVOLVULUS, OR BINDWEED

A plant which has lovely flowers but annoying habits is this common convolvulus of British fields. Its fragrant blossoms close almost at once when picked, and also at night and in wet weather. The creeping roots are most difficult to get rid of when they invade gardens.

bindweed has thicker, heart-shaped leaves and large pink flowers, and grows on sandy coasts. A bluish-purple striped convolvulus from southern Europe used to be grown in English gardens.

Cook, Captain James (1728–79). In Fitzroy Gardens, Melbourne, Australia, there stands the Yorkshire cottage where Captain Cook spent his boyhood. It was bought, taken down, and shipped to Australia by the government of Victoria in 1934, and is now a monument to the first Englishman to set foot on Victorian soil.

Cook was a quiet, modest man, son of a farm-labourer, and became one of the most remarkable navigators the world has ever seen. His discovery of the east coast of New Holland (afterwards Australia) and his annexation of that continent for the British Crown, his exploration of Pacific and Antarctic regions, and his survey of the American and Asiatic coasts in his quest for the "North-West passage"—these achievements suffice to place him among the famous. But his common sense and humanity made him also the pioneer of reform in the conditions of seamen. To-day it is hard to realize the dreadful hardships in the Royal Navy and the Merchant Service, which continued well into the 19th century. Filth and its resultant infections, and scurvy, were responsible for far more deaths among sailors than the worst enemy action or shipwrecks. When Cook set out on his expeditions he insisted on cleanliness aboard, so much so that it was remarked "on Cook's ships it seemed always Sunday."

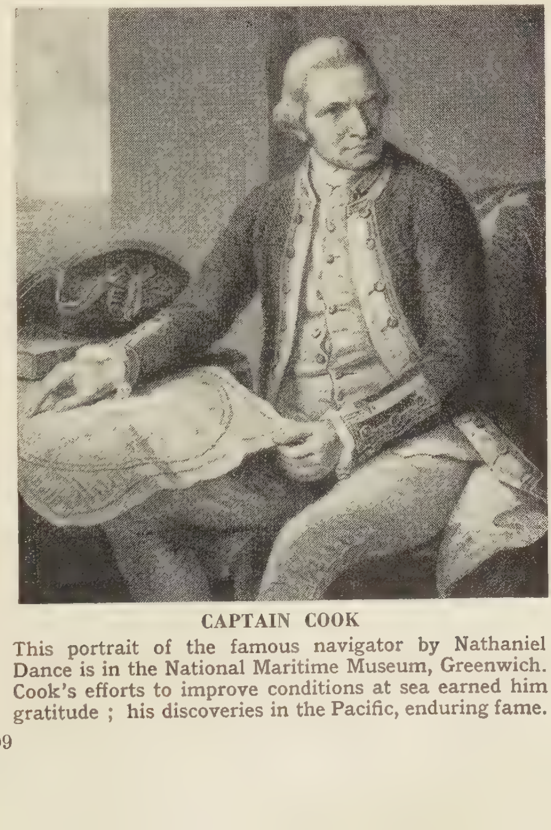
It was known that scurvy, the menace of long voyages, was caused by the absence of fresh food. Cook cared enough for his men to act upon this knowledge and saw to it that they had plenty of fresh water, and were properly nourished, punishing those whose dislike of new kinds of food prevented them from eating sensibly. Among his anti-scorbutic foods were *sauerkraut*, washed greens preserved between layers of rock-salt and "wort," a preparation made from unfermented malt. As recently as 1938 a cake of Cook's "portable soup" was analysed. This was a dried broth made from meat and bones and looking rather like hard glue, and was still fresh after 160 years!

Cook's first expedition, in 1768, took him to the South Pacific to make astronomical observations and geographical studies. This took him, by way of the Society Islands and New Zealand, to "New Holland." He called the part where he landed "New South Wales" because of its resemblance to the coastline of Glamorganshire. On his return, in 1771, he was promoted commander.

His second expedition, starting in 1772, was for the purpose of discovering or disproving the existence of the "Southern Continent." He explored the Antarctic regions, charted and studied the conditions in Easter Island, the Marquesas, and the Friendly Islands, and re-crossed the Antarctic Circle from South Australia to Tierra del Fuego.

On this third and last voyage, on which he hoped to find a Pacific entrance to the North-West passage, Cook discovered the Sandwich (Hawaiian) Islands and surveyed the Alaskan coast up to the Bering Straits. Returning to Hawaii, he met his death at the hands of natives who wanted to prevent him from holding their chief as a hostage against the return of a stolen boat. His murder was doubly tragic because Cook had always treated native peoples justly and well.

Cook's six children died young: his widow lived until she was 93 and destroyed all personal letters, so that little is known of his private life. But if he is judged by the regard of those who knew him, it is plain that he is entitled to respect and admiration, not only as an explorer and navigator, but as a brave and honest man.



CAPTAIN COOK

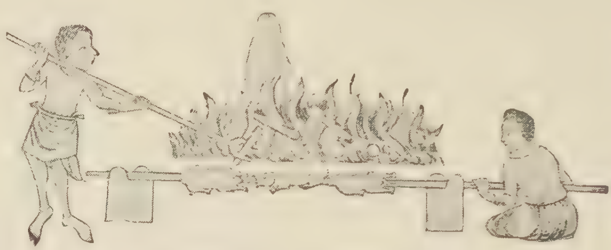
This portrait of the famous navigator by Nathaniel Dance is in the National Maritime Museum, Greenwich. Cook's efforts to improve conditions at sea earned him gratitude; his discoveries in the Pacific, enduring fame.

HOW *and* WHY WE COOK OUR FOOD

Cookery. The preparation of food by fire, or cooking, is probably as old a process as man's discovery of fire. Many foods would not suit human digestive systems unless they were cooked in some way, though there are quite a number, such as fruits, salads, and milk, which may be (or, like salad, must be) eaten raw.

The whole idea of cooking is to soften the tissues of food so as to make chewing less tedious, at the same time making the food easy to digest as well as pleasing to the taste—palatable as it is called. Poor cooking can turn the finest food into something unpalatable, unsavoury, and quite indigestible. Good cooking can make even the plainest fare so appetising that one feels refreshed and glad to have eaten the meal.

Charles Lamb, in an essay entitled "A Dissertation on Roast Pig," tells a wonderful story of how the custom of roasting pig is supposed to have started with the burning of a Chinese house, in the flames of which a pig perished. The accidentally-roasted pig was eaten—and so enjoyed that those who partook of it burned down more houses to get further tasty morsels. This went on until it dawned on them that it would be less destructive to find a way of roasting pig without burning houses !



COOKING IN EARLIER DAYS

The Luttrell Psalter has proved useful in providing details of life in bygone days (14th century). In this sketch from the Psalter a cook is seen roasting sucking-pigs while another stirs the fire.

Even primitive peoples, such as the American Indians, knew almost every form of cooking. Among the kings of ancient Egypt and Assyria the elaborate preparation of food was well known ; evidence of this is found among cooking utensils unearthed in the kitchen quarters of their palaces, and in paintings on the walls of their tombs.

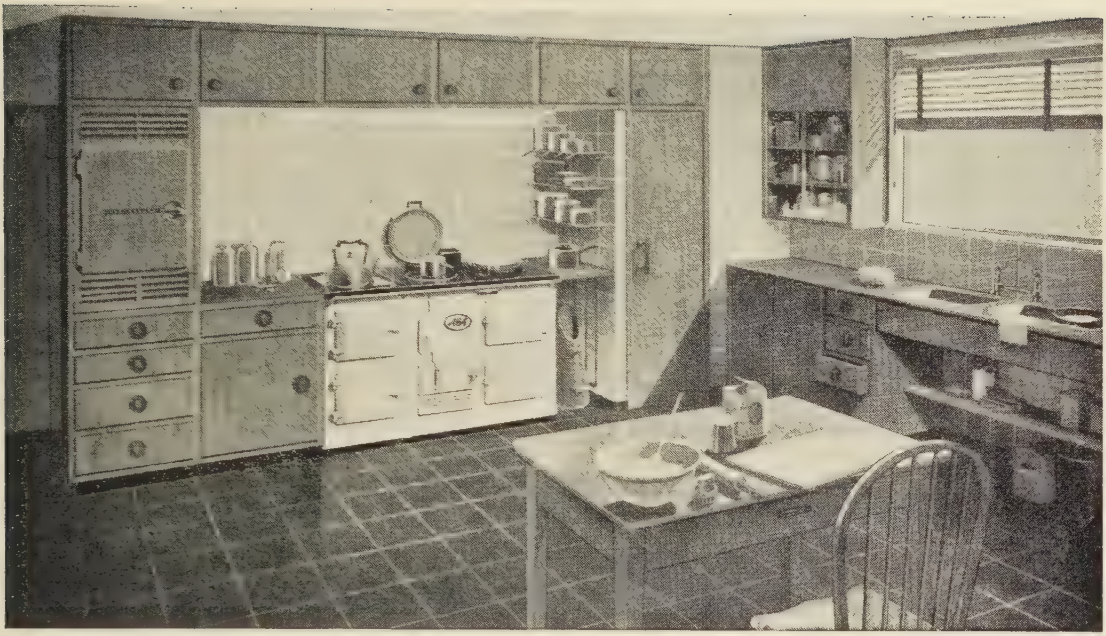
The style of cooking has changed with the style of table manners. Before the introduction of forks and spoons, for instance, preparation of food for the table had to be much simpler than it is nowadays ; food had then to be presented in a form which could be handled with ease. Later, when forks and spoons appeared, food was garnished elaborately ; and not only cooking, but also the art of dining, made marked progress in refinement and civilization.

In the early days cooks were counted of some importance. William the Conqueror granted the manor of Addington to his cook, Robert Argyllon, for the service of a dish called "de la Groute" on the king's coronation day. To this day the lord of the manor of Addington can claim the right to present such a dish on the coronation day of the Sovereign. In the 20th century cooks are not given so much prominence as some of them had in the 11th, but they are very important in hotels and restaurants.

There are several means of cooking. Some, although old-fashioned, are still effective and in some remote places may be the only available method—such as the open fire with perhaps a baking oven at the side or beneath, or an oil stove with an oven fixed above. In contrast there are the anthracite or coke slow-combustion heat-storage stoves with ample oven space, having very hot, medium, and slow chambers ; and modern gas stoves and electric ones, with both boiling and simmering rings, grillers, and spacious ovens. Where a supply of piped gas is not available, gas stoves can be run on "Calor" gas supplied in cylinders. Such stoves are portable, and can be used in caravans, motor-boats, and so on, as well as in dwelling-houses. Whatever the fuel used, all these modern stoves are fitted with regulators and produce even, controllable heat, with great advantages over the old open-fire or kitchen range, which needs constant replenishment, causing fluctuating degrees of temperature. The pressure cooker (a special type of saucepan) is another modern method which saves considerable time and fuel by cooking food at very high temperatures for a very short time.

Heat for cooking is applied to the food either by radiation or by direct contact. Radiation includes roasting, baking, and grilling ; direct contact means frying, boiling or stewing, and steaming. We often speak of "roasting" meat when we should say "baking." Properly speaking, when you roast meat you hang the joint before an open fire. In the Middle Ages an animal was sometimes roasted whole, in preparation for a banquet. In roasting meat, it had to be turned constantly so that it was cooked evenly on all sides, and basted frequently with hot or boiling fat to prevent any charring or drying. This part of the cooking was done by a boy who was called a turnspit, because the meat was placed on a spit—that is, a thin pointed rod. Legend tells us that Gareth, one of the knights of the Round Table, served for a time in King Arthur's kitchen, performing such menial tasks. In very large kitchens, where much roasting had to be done, the spit was sometimes attached to a wheel which was turned by a small dog running round inside it and thus revolving the spit. True roasting is considered the best way of cooking meat to keep the flavour.

Grilled meat is cut in strips or slices or chops, and in olden times was held over the open fire on either a spit or a grid. Nowadays most people have a gas or electric griller, under which the meat is placed on a hot grid over the pan, the



Aga Heat, Ltd.

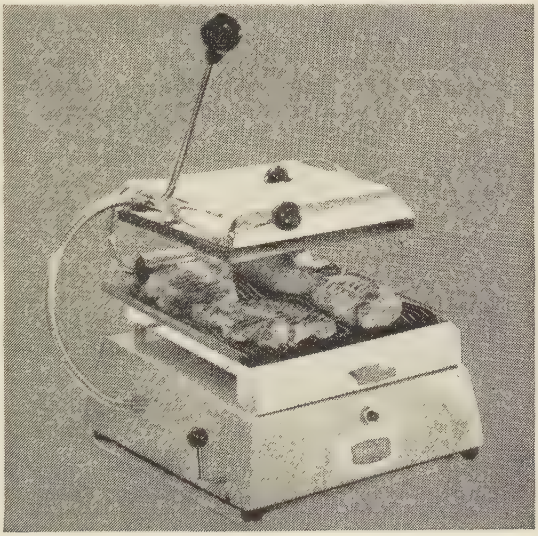
A COOK'S WELL-ARRANGED WORKSHOP

This is the kind of kitchen every girl interested in cooking would like to work in. The stove is a special design for burning coke or anthracite and stores its heat so that it does not require frequent stoking. It keeps burning for many weeks at a time. On the right of the stove is a cupboard for brushes and brooms, and on the left is a refrigerator with drawers underneath. The two sinks under the window are served by a tap which swivels from one to the other.

griller having previously been made red hot. If grilling were started with a cold griller, it would cause the juices of the meat to escape ; and if the raw meat were placed on a cold grid, the meat would stick to the grid. Grilled food needs to be turned every two minutes to prevent it from drying unevenly.

Baking means cooking food in a closed oven by dry heat, (that is, without steam). The primitive method of baking was to dig a pit, line it with stones, and build a fire in it. When the fire died down, the ashes were raked out. Then the food was wrapped in leaves and placed on the hot stones, and the top of the pit was covered with more leaves and earth to hold in the heat. Sometimes water was poured in to make steam for the cooking of certain dishes. When the pit was opened, the food was found to be deliciously baked in its own steamy juice. In the cattle country of western America a " barbecue " always means food (usually a whole animal) cooked in a pit. But nowadays " barbecue plants " ranging from rough brick frameworks to up-to-date, movable metal charcoal-burners are becoming increasingly fashionable to have in the garden, and barbecued meat has come to mean meat cooked out of doors, over an open fire in a grate. Another primitive way of baking food, which Gypsies and tramps still sometimes use, is to wrap up fish or meat, or any other kind of food, in leaves, then smear it all over with clay, and place in it hot embers or ashes. When it is cooked, the clay and leaves are carefully broken off, revealing the well-cooked food with none of its juices lost.

When baking in a modern oven, the oven should be made hot before cooking begins. Once food has been put in the oven, an even temperature must be maintained, unless, for instance, a cake recipe gives instructions otherwise. The oven door must never be slammed, because this creates a draught which causes cakes and pastry to sink and become heavy ; bread would very easily spoil and become heavy, too. Meat needs a very hot oven at first to sear (or seal up) the surface and so prevent



COOKING THE QUICK WAY

This domestic cooker, which is fitted with infra-red elements and silicone-treated plates, will cook almost anything, from snacks to a complete meal. It saves a lot of space in the kitchen and is very quick.

Courtesy of the Prestige people

FUEL SAVING IN COOKERY

Any vegetables which have roughly the same cooking times can be cooked together in a pressure cooker. Each vegetable retains its individual flavour and only one burner (gas) or hot-plate (electric cooker) is used.

Courtesy of the Prestige people

PRESSURE COOKING IN BOTTLING

This pressure cooker has a lid with three-way pressure control (15, 10, and 5 lb.). For bottling fruit or vegetables it holds three two-pound standard-make jars; five one-pound jam jars or three two-pound jam jars.

the juices from escaping. Heat is then reduced to allow sufficient time for thorough cooking to soften the connective tissues of the meat without drying the outer surface too much.

Bread and pastry need a hot oven. If the oven is not hot enough the air in the pastry mixture will not expand sufficiently to raise and lighten the flour. Instead, the fat in the mixture will press down the flour as it melts, thus making the pastry heavy and indigestible. With bread, the dough (containing yeast) is given a certain amount of time to rise (or ferment) in a fairly warm, draughtless place before being placed in the oven. When the dough is put in to bake, the oven needs to be hot so that the yeast-plant will be killed and thus prevent any further fermentation. (*See* Bread and Biscuits.)

Most light cake mixtures need a medium (but some a slow) oven in order that the outside shall not become browned before the inside is fully cooked. Cakes with a small amount of fruit in their mixture require a medium oven at first to set the fruit and prevent it from falling to the bottom of the mixture; then the regulator can be lowered, or if there is no regulator the cake can be placed on a lower shelf in the oven to finish cooking. Cakes containing treacle or a large amount of sugar or fruit must be placed in a slow oven.

Since milk scorches very easily, milk puddings need cooking for a long time in a slow oven. Strangely enough, modern ovens do not produce (economically) such good milk puddings as the old-fashioned kitchen ranges where, as one old recipe states, "the pudding should be put in after the cooking for the day is finished, and should remain there all night and all the next day till required, when it will taste like cream."

Frying is cooking in a pan containing fat, over a fire, a gas-ring, the boiling ring of an electric cooker, or the hot-plate of a slow-combustion stove. The nearest that primitive people came to frying was to place food on a flat stone over a fire. The result was more like parching or baking. Frying can be either deep, the food being placed in a deep wire basket and immersed in boiling-hot fat; or shallow, the food being placed direct into

COOKING BY GAS

Modern gas cookers are easy to clean, and an adjustment scale controls the temperature. The type seen in the photograph has a griller at eye level, and the burners light automatically when the appropriate switch is turned.

a shallow pan with sufficient smoking-hot fat to prevent it from sticking to the pan or burning. Good frying depends entirely on the heat of the fat. Fish which has been dipped in batter and fried in deep fat should, when cooked, be crisp on the outside; it will be if the fat was boiling hot. Unless very carefully cooked, meat does not fry well; the fat coats the fibres and renders the meat highly indigestible. Grilling is preferable to frying.

Boiling and stewing mean cooking in a saucepan with the aid of water or other liquid, the food being completely covered with the liquid. When food is

to be boiled, the water is sometimes brought to the boil with the food in it. This must be done slowly, or food will not cook thoroughly. Green vegetables are immersed in boiling water, and the pot is kept boiling. The stewing of meat is a useful way of using up tough pieces or sinewy pieces with a lot of bone, also trimmings and fragments which could not be served as a separate dish. Stewing is a slow process.

Steaming is cooking food in a perforated vessel suspended over the steam that rises from constantly boiling water. A pudding can be steamed in this way or by making it in a basin over which a cloth is tied. The basin is then placed in a covered saucepan of boiling water, the water reaching only two-thirds up the side of the basin, and the whole is kept simmering for the required time.

Not only does cooking improve the taste of food, making it easier to digest, but the heat kills bacteria and parasites which might be harmful and which could not be removed by cleansing the food. (*See* BACTERIA ; CANNING.) Food should be so cooked that its nutritional value is not destroyed. Meat should be cooked so that it becomes tender and yet does not lose its juices. The tough fibres of cereals should be softened by long and thorough cooking, so that they can be completely digested. Vegetables should be cooked so as to retain their minerals and vitamins ; if these are absorbed into the cooking water, most of the food value is lost. The more the water and the longer the cooking, the greater is the loss. Vitamin C is wholly destroyed by long cooking. The basic rule for cooking vegetables, except when making soup, is to cook them in as little water and for as short a time as possible.

Cabbage, in particular, has been much maligned, having often been cooked for too long in too much water. When drained, it should be "finished off" in a little melted butter or margarine.

Eggs, milk, and cheese are protein foods, like meat ; and they, too, react badly to high temperatures. Eggs toughen and curdle, and cheese becomes stringy, while milk scorches easily.

Inventors have given the modern cook all sorts of good equipment, such as double-cookers which protect easily scorched or curdled foods from too fierce cooking ; fireless (*e.g.* haybox) cookers which save fuel ; electrical devices (thermostatically controlled) which turn ovens on and off at desired temperatures ; pressure cookers which save hours in boiling tough meat or soups—stews will cook in about 12 minutes, potatoes in five minutes, fresh peas in one minute, and greens in two or three minutes. The housewife can now sit at the dining-table and prepare toast, waffles, or coffee with electrical appliances in a few minutes.

Recipes were largely a matter of tradition until the advent of "Mrs. Beeton." True, cookery books had been published before—charming ones with passages written in verse or in the form of dialogues. But they were concerned with cookery as one of the fine arts and were of little use to the ignorant young bride. By the 19th century, with the rise of the "merchant class," whose daughters, unlike those of the landed gentry, were usually brought up without experience in household matters, a reliable cookery book with a classified index was badly needed. It was provided by Isabella Mayson Beeton's *Household Management*. She, a publisher's wife who died when she was 29, put together and edited this huge volume which became a best-seller second only (it is said) to the Bible. Year after year the publishers brought the book up to date : year after year the firm had to apologise because they could not produce enough copies to satisfy the demand. *Household Management* took its place on the British shelf, and despite new inventions, rising prices, and the tin-opener, it has never been entirely dislodged.

Drawing by H. M. Brock (Macmillan & Co., Ltd.)

WHEN "KILL-DEER" SPOKE

Here is an incident from *The Last of the Mohicans*. Hawk-eye, the scout, has just fired his rifle, "Kill-deer," at the pursuing Hurons. The canoe is forced forward by Uncas and Chingachgook. In it, too, are Captain Duncan Heyward and the veteran Munro.

Cooper, JAMES FENIMORE (1789–1851). The author of the first "Red Indian" stories has been called "America's first national novelist." The son of a Congressman of wealth and position, Cooper grew up on the family estate on the shores of Otsego Lake, New York, beyond which lay vast tracts of primeval forest. He was expelled from Yale University for causing a gunpowder explosion in a classroom and placing a donkey in a professor's chair. After this he spent five years in the U.S. navy (this period was later reflected in his sea stories), and then became a farmer. One day

he read an English novel and made a bet with his wife that he could write a better book. The result was *Precaution* (1820), a story so successfully modelled on Jane Austen's *Persuasion* that his publishers succeeded in passing it off as the work of an Englishman. He then wrote *The Spy* (1821), a tale of adventure, and this enjoyed great popularity. Writing rapidly, without revision, he then published a novel a year for several years. In 1826 *The Last of the Mohicans* brought him world fame. This and his other novels about 18th-century America became known as "The Leatherstocking Tales," from the nickname of the hero of them.

Cooper had a perverse and argumentative nature. When in England, he annoyed people with his aggressive "Yankee boasting"; and when he was in America, he was strongly critical of his fellow-countrymen. He made himself still more unpopular by suing a series of newspapers for libel, and it may be said that his wrong-headedness caused many unfair criticisms of his books, some of which fell into undeserved neglect.

His chief works beside those already named are: *The Pioneers* (1823); *The Pilot* (1824); *The Prairie* (1826); *The Pathfinder* (1840); *The Deerslayer* (1841); *The Two Admirals* and *Wing-and-Wing* (1842); *Afloat and Ashore* (1844).

Co-operative Societies. Great Britain's co-operative societies were born through the efforts of poor people to help themselves and one another in years of hardship. In 1844, when wages were low in England and food very dear, a group of weavers in Rochdale saved a few pence every week until they had £28, and acquired a small shop. There they sold food at the same price as other grocers, but their profits were divided and given back to the customers in proportion to the money each had spent in the shop. The scheme was so successful that others took up the idea, and to-day more than 11,000,000 people in Britain are members of co-operative societies run on the same lines as the little shop in Rochdale and selling not just groceries, but goods of every description, and services ranging from haircuts to funerals.

Anyone can buy from a co-operative shop, but only members are entitled to the profit-sharing, or dividend, as it is called. A person becomes a member on purchasing a share, the price of which may vary from 1s. to £1 according to the store. It gives him one vote in the management of his store, and entitles him to a fixed rate of interest on that share. A member may invest up to £500 but he will still have only one vote, which means that nobody can gain a lot of money or power in the society at the expense of others. Each member has a number, and each purchase is credited towards his annual dividend.

The co-operative movement spread rapidly, and the societies soon began to get together. In 1863 the English retail societies founded the Co-operative Wholesale Society. A Scottish society followed in 1868. The more goods you buy at one time, the cheaper they are—so the C.W.S. bought large quantities at a low price and sold them without profit to the retail societies or shops, who sold in turn to their members. Next it started making or growing suitable goods. To-day the C.W.S. manufactures many millions of pounds' worth of goods a year. It has penetrated into many types of business, and has tea plantations in Ceylon and 40,000 acres of land in England.

Producers' co-operative societies were not a new idea, but earlier efforts had failed because their promoters aimed too high, especially in attempting to form community settlements on idealistic lines. The later idea of simply producing goods at a reasonable price was fully practical and therefore successful. But the co-operative movement has always been inspired by the idealism of its pioneers especially Robert Owen (1771–1858).

Besides having a central trading organization, the co-operative societies joined for general purposes in the Co-operative Union, founded in 1869. One of the earliest principles of the movement was to set aside a small proportion of the profits for education, and at present it supports libraries and organizes week-end schools. In 1917 the political Co-operative party was formed. In the main it works with the Labour party.

The co-operative movement has spread all over the world, especially in the west, and members from many countries meet in the International Co-operative Alliance. Denmark's farming and Sweden's publishing trades are run to a great extent on co-operative lines. Because the system cannot be upset through personal greed or am-

TOWN HALL SQUARE IN COPENHAGEN

Copenhagen's town hall, completed in 1901, was built in the Renaissance style, with a tower 345 feet high. The capital of Denmark stands on two islands—Zealand and Amager—at the entrance to the Baltic Sea. It is a busy, thriving port.

Danish Travel Assn.

THE LITTLE MERMAID

This famous figure from Hans Andersen's Fairy Tales is poised on a rock near the Langelinie promenade, Copenhagen. Outstanding in a city of numerous works of art, the mermaid, work of the sculptor Edvard Eriksen, attracts photographers from all over the world.

bition, and because it deals with things people need and not with ideas about which they can disagree, it has proved itself in the last hundred years to be among the most successful of democratic ideas.

Copenhagen, DENMARK. The Danish name of the capital of Denmark is *København*, meaning merchants' harbour. The city stands on the east coast of the island of Zealand, an hour's journey by steamer across the narrow Sound from Sweden, and is bordered half-way round by the sea and numerous quays. It is a place of ships and seamen, and canals bring the sea deep into its heart. At the north end is the great free port, with grain elevators and warehouses. A park-like promenade, the Langelinie (Long Line), extends from here along the Sound to the moated Citadel, now a military barracks. The excellent main harbour is formed by the deep, narrow channel between Zealand and the small island of Amager.

Wide boulevards and parks bordering a chain of lakes where the old ramparts used to be, busy market squares, and the general air of bustle and gaiety, have earned Copenhagen the name of "the Paris of the North." There are many fine public buildings, museums, art galleries, and churches. The gilded dome of the Frederikskirke (Marble Church) is a notable sight, and Trinity Church has a round tower over 100 feet high, in which is a spiral roadway and an observatory. The finest of the city's palaces is the Christiansborg, in which the Danish parliament meets. The Amalienborg, the principal royal residence, consists of four separate palaces surrounding a large cobbled square. Copenhagen's famous zoo is housed in the grounds of Frederiksberg Castle.

The first thing a visitor notices in Copenhagen is that everyone seems to ride a bicycle. At the rush hours bicycles crowd the streets, and everywhere are close-ranked stands where workers and shoppers can leave their machines. Another sight is the stream of Copenhageners heading every summer evening for the Tivoli, the most comprehensive pleasure garden in Europe. Occupying a large area in the centre of the city, it contains theatres, bandstands, a concert hall, a dance hall, twenty-one restaurants, and a complete fun fair.

Copenhagen was founded as a military citadel in 1167. Because of its fine harbour and commanding position at the entrance to the Baltic Sea, it grew rapidly into a flourishing commercial city. Its industries include shipbuilding and engineering, distilling and brewing, fishing, and the manufacture of textiles, pianos, porcelain, and mathematical instruments. The chief exports are dairy produce, sugar, beef, and hides.

Copenhagen became the capital of Denmark in 1443. It was attacked several times by the Swedes in the 17th century. In its harbour on April 2, 1801, Nelson defeated the Danish fleet, as the result of a quarrel between Denmark and Great Britain over the right of British ships to search neutral vessels during the war against Napoleon. On August 3, 1807, the city was bombarded by a British fleet to enforce the surrender of the Danish fleet in order to prevent it from falling into the hands of the French. In the Second World War, Copenhagen was occupied by German forces during 1940–45. The population of Greater Copenhagen in 1956 was 1,292,772—more than one-quarter of the total population of Denmark.

Copernicus, NICOLAUS (1473–1543). In the little town of Frauenburg, Poland, in the month of May 1543, an old man lay dying. But on his face was a smile of content, for he held in his hand a printed copy of a great book.

The man was Nicolaus Copernicus (Mikolaj Koppernigk, in Polish), the founder of modern astronomy, and his book bore the title *De Revolutionibus Orbium Coelestium* (Concerning the Revolutions of the Heavenly Spheres, *i.e.* the "crystal spheres" carrying the sun, moon, and planets, *not* the bodies themselves). In this work Copernicus proved that the earth was not the centre of the universe, around which moved the sun, moon, and stars. The earth, he showed, is one of several heavenly bodies which all revolve about the sun.

Copernicus (pron. kopê′nik*us*) was the son of a Polish trader, who died while Nicolaus was a child. His uncle, who became bishop of Ermeland in 1489, had looked after the education of the boy. At the University of Cracow, in Poland, Nicolaus had studied mathematics. Afterwards he went to Bologna in Italy, where he varied his study of Church law with studies of the stars; and a few years later he studied medicine in Padua.

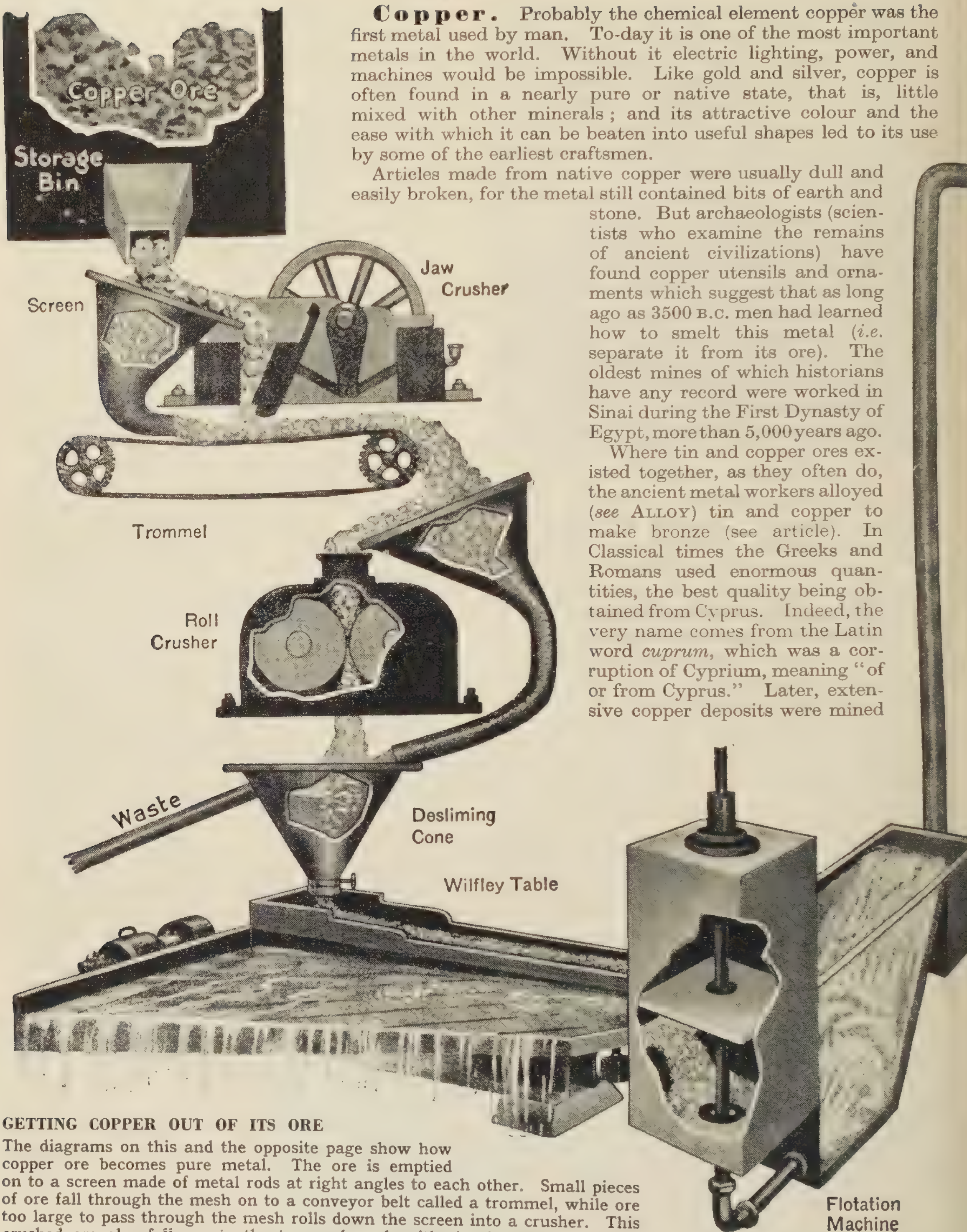
Then he went back to Poland as his uncle's physician, and on his uncle's death in 1512 he retired to Frauenburg, having been made a canon of the cathedral there when he was 24. Here he divided his time between the duties of his office, medical practice, and the close study of astronomy.

He had finished his great book, setting forth the proof that the sun is the centre of the universe, in 1531; but at first he would not publish it, although an outline of it had been approved by the Pope. At last one of his pupils persuaded Nicolaus to give his book to the world, and a printed copy of it came to him just a few hours before his death.

Copper. Probably the chemical element copper was the first metal used by man. To-day it is one of the most important metals in the world. Without it electric lighting, power, and machines would be impossible. Like gold and silver, copper is often found in a nearly pure or native state, that is, little mixed with other minerals; and its attractive colour and the ease with which it can be beaten into useful shapes led to its use by some of the earliest craftsmen.

Articles made from native copper were usually dull and easily broken, for the metal still contained bits of earth and stone. But archaeologists (scientists who examine the remains of ancient civilizations) have found copper utensils and ornaments which suggest that as long ago as 3500 B.C. men had learned how to smelt this metal (*i.e.* separate it from its ore). The oldest mines of which historians have any record were worked in Sinai during the First Dynasty of Egypt, more than 5,000 years ago.

Where tin and copper ores existed together, as they often do, the ancient metal workers alloyed (*see* ALLOY) tin and copper to make bronze (see article). In Classical times the Greeks and Romans used enormous quantities, the best quality being obtained from Cyprus. Indeed, the very name comes from the Latin word *cuprum*, which was a corruption of Cyprium, meaning "of or from Cyprus." Later, extensive copper deposits were mined



GETTING COPPER OUT OF ITS ORE

The diagrams on this and the opposite page show how copper ore becomes pure metal. The ore is emptied on to a screen made of metal rods at right angles to each other. Small pieces of ore fall through the mesh on to a conveyor belt called a trommel, while ore too large to pass through the mesh rolls down the screen into a crusher. This crushed ore also falls on to the trommel, and, with the fine ore, is carried to another screen, which further separates and sieves the ore. The very small pieces fall direct into the desliming cone, but the larger lumps first pass between two rollers which grind them to a fine powder. In the desliming cone the powdered ore is shaken up, and the earthy part of the ore, being lighter than copper, is thrown to the top, where it is dissolved in water and flows away as waste. The copper, which is heavier than the earth, but which still contains a lot of sandy material, falls on to a Wilfley table which separates the pure copper from the pieces of sand-bound copper. The pure ore goes to a furnace for smelting, while the sandy copper falls into a flotation machine, so called because it "floats" the copper off the unwanted sand.

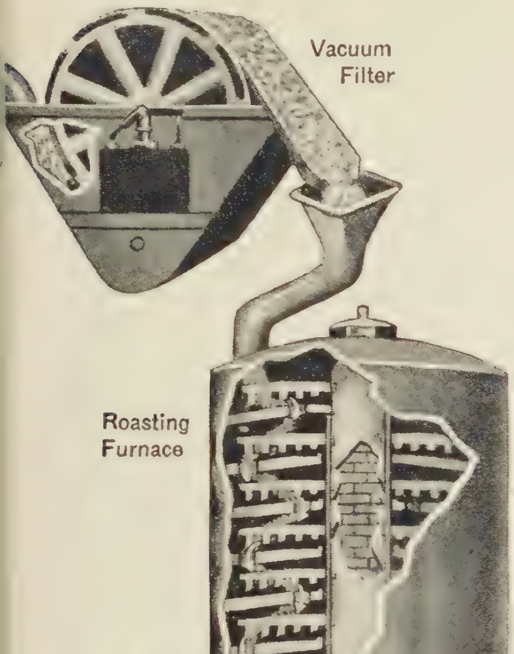
by the Romans in Cumberland and North Wales, the copper being alloyed with Cornish tin to make bronze.

Britain continued thereafter to be the centre of the copper industry, and until the end of the 19th century nearly the whole of the world's requirements were smelted at Swansea, Wales, from ore mined in Cornwall and Spain. Then deposits of copper ore were found in North America, Chile, and Australia. For some years the ores from these places were shipped to Swansea for smelting, but eventually it was found cheaper to smelt near the mines, and the British industry declined. Important producers of copper are the United States, Chile, Northern Rhodesia, the Belgian Congo, Canada, Russia, Cyprus, and Australia.

Copper ore is either obtained from quarries or pits (open cast) or has to be brought up from mines many hundreds of feet below ground. The chief copper-bearing ores are chalco-pyrite, bornite, chalcocite, covellite, enargite, malachite, azurite, and cuprite. All these also contain other minerals, chiefly iron and sulphur.

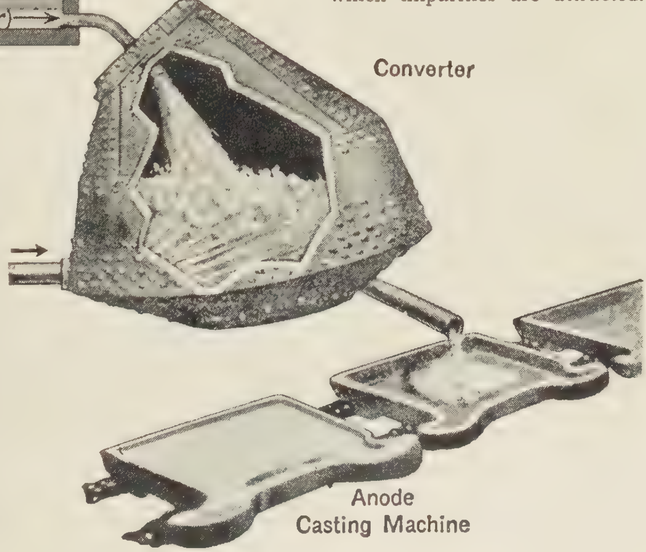
After it has been mined the copper ore is broken by machinery into small lumps which are ground to powder in a ball mill, a revolving steel cylinder holding several tons of steel balls which pound the ore. The copper is separated out in a flotation machine, and after treatment by other processes, passes to a furnace which melts it.

Pure copper combines good mechanical strength with the property of being easily worked. It can be drawn while cold into wire one thousandth of an inch in diameter, or rolled into sheets less than one five-hundredth of an inch thick. It can also be pressed, forged, beaten, or spun into all kinds of complicated shapes.



PURE COPPER AT LAST

There still remain some unwanted materials in the copper, and these are removed in the converter, where another blast of air blows them out of the top. From the converter the molten copper is poured into moulds, called anode castings. For some purposes the copper is now ready for use, for others it needs more refining and is put through an electrical process, whereby moulded ingots form the anodes, from which impurities are attracted.



HELP FROM AIR, FIRE, AND WATER

In the flotation machine the sandy copper is mixed with oil and forced on to water rising towards the end of a pipe. The copper clings to the oil and with it is carried up the rising column of water (oil being able to float on water). The sand which does not contain any copper will not cling to the oil but falls to the bottom of the flotation machine as waste. The copper ore from the various separation processes now passes through a vacuum filter, which gets rid of the oil, water, and sand, and sends the partly-refined ore into the roasting furnace. There revolving arms sweep the copper down platforms inside the furnace, and the copper loses more of its impurities, including its sulphur content, which a jet of air blows from the molten copper that pours from the furnace.

Copper conducts electricity better than any other known substance except silver. About half the world production of copper is used for electrical work. Light and telegraph lines, power and submarine cables, trolley-bus and tramway overhead lines, the windings of generators, electric motors, and fans all depend on copper.

For such purposes as long-span overhead electricity cables, pure copper is not strong enough to support its own weight, but it can be reinforced by adding 0·9 per cent. of cadmium.

Copper is also a very good conductor of heat, and is extensively used in motor-car and aeroplane engine radiators. It does not easily rust or corrode, and it can readily be joined by soldering or welding. The amazing lasting qualities of this metal are shown in the fact that objects made from it thousands of years ago still remain intact. The addition of arsenic gives greater strength and corrosion resistance, arsenical copper being used in the engineering industry for boilers, tubes, condensers, and shafts.

Among other uses of copper and its many alloys are the making of plates for engraving and etching, rollers for calico printing, ornaments, and, as an alloy, coins. Great Britain's former silver coins are now made of an alloy of copper and nickel called cupro-nickel. Chemists extract from copper a host of useful substances such as copper chloride, a valuable disinfectant; copper sulphate, used for preserving timber and to destroy fungus on grape vines and other plants; and copper salts, used for colouring glass.

Coral. Perhaps the greatest of all nature's builders are the little coral-making organisms called polyps, creatures of shallow water in the warmer seas. Small as these tiny workers are, each one plays his part, until speck by speck a new land is created to become the home of man.

There are leaf corals, and others shaped like vases; some branch out like the horns of a stag. The red and delicate salmon-pink coral, used in making jewelry, occurs at its best only in certain parts of the Mediterranean Sea, off the coast of Africa and the west coast of Italy, where coral fishing is an important industry. This belongs to a different species from the reef-building corals.

The coral polyp begins life as a free-swimming little creature, but after a time it settles on a rock or a piece of dead coral and begins to live like a plant, having lost its power of moving from place to place. Indeed, corals were thought for a long time to be sea-flowers.

As a polyp develops, little feelers like petals appear about the mouth. Stretching out these feelers or arms, the polyp catches and feeds upon tiny organisms floating in the sea, and builds for itself a skeleton with secretions of lime. A few kinds of coral continue to live as solitary individuals, but most of them live in vast colonies of many thousands of polyps so closely connected that it is impossible to see where one individual leaves off and another begins. The parent polyp produces little buds which develop feelers and stomachs, and these in their turn give rise to new buds—all of them remaining in association as one great family, joined together inextricably.

CORAL QUARRYING IN KENYA

Mombasa, the chief port of Kenya Colony, is built on a coralline island; thus coral is the most plentiful general building material. Workmen are here seen quarrying coral near a main street in the centre of Mombasa. Powdered coral is put to many uses in industrial chemistry and also in constructional materials.

As the polyps die, the skeletons accumulate, forming a solid mass, and in the course of centuries new land appears above the surface of the sea consisting of nothing but the skeletons of billions of billions of dead polyps. The flesh or living part of most coral is a pleasant orange-yellow.

Coral islands and reefs are most numerous in the warmer portions of the Pacific and in the Indian Ocean, occurring to a lesser extent in the Gulf of Mexico and along the shores of the West Indies. According to their various forms, they belong to one of three classes. Barrier reefs lie at some distance from the land, the space between being filled by a shallow lagoon of salt water. Usually some parts of the reef rise above the ocean as islets, supporting a scanty vegetation, while the greater part is submerged. The Great Barrier Reef of

LOVELY BUILDERS OF CORAL REEFS AND ISLANDS

These diversely coloured and variously shaped corals are skeletons of colonies of minute marine animals, named polyps, which have been formed from secretions of lime obtained from the water by these creatures. The fish vie with their environment in gaiety of tint and marking. Those in the photograph are Electric Blues and Humbugs.

The species of coral found on the Great Barrier Reef, off the north-east coast of Australia, number several hundreds, but the most widely distributed is the staghorn, which derives its name from the antler-like appearance of the branches, as can be seen in this photograph. Some corals lose their brilliant colouring when taken out of the water. The flesh or living part of most coral is orange-yellow. At right centre is seen a small canary fish

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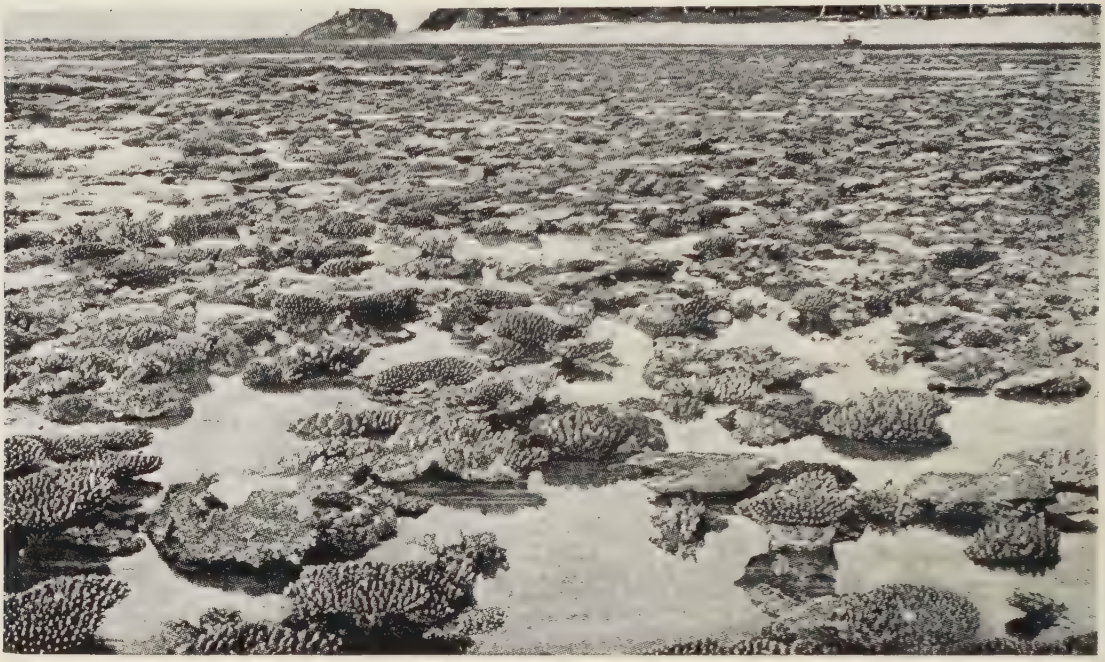
THE ANIMALS THAT MAKE CORAL



From Capt. Frank Hurley's "Pearls and Savages" (Putnam's Sons)

Tiny architects of the sea, the coral polyps and their work are in tremendous evidence in the shallow warmer waters. Incredible variety in form and colour is displayed, and sometimes vast areas are covered, as in this picture of a portion of the immense Great Barrier Reef off the Queensland coast at low tide. At high tide the the reef is all but invisible. When the sea ceases to cover the coral (through disturbance of the sea bed or other cause), the polyps affected die, and their solid remains become bleached by exposure to winds and sun.

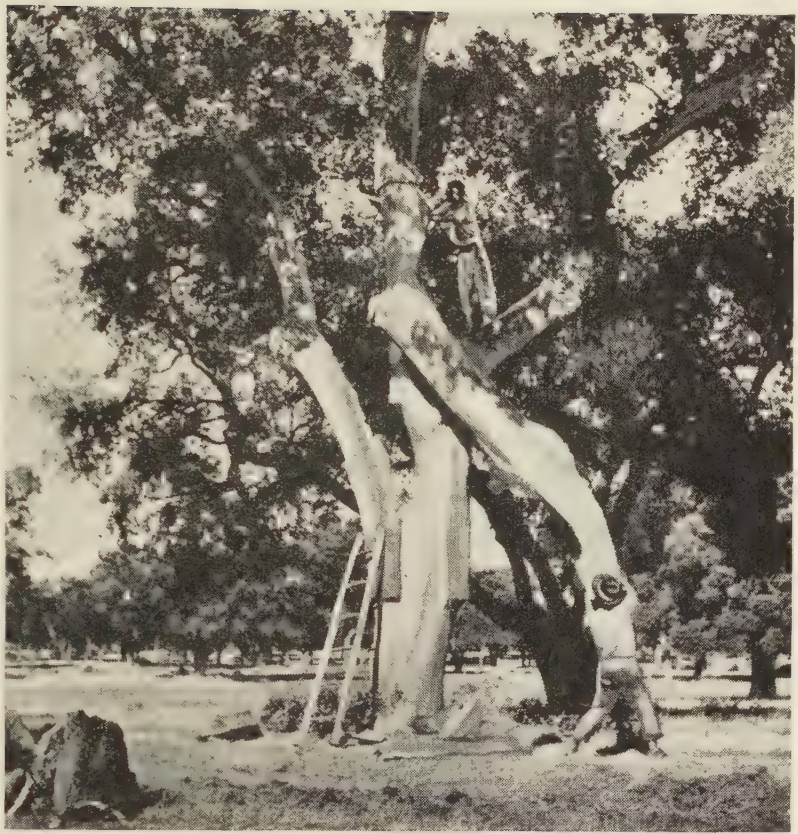
What causes the very minute coral animals to unite and to build so industriously, in such strange diversity of form, is just one more of nature's baffling mysteries. The colony of countless millions of polyps seen in this picture might be mistaken for a stunted, spiky shrub.

Three further examples from the thousands of species of coral. The innumerable builders have lived their very brief lives, leaving as evidence of their existence these quaintly beautiful accumulations of limy skeletons. The specimens grouped here are from the Indian Ocean.

Australia, over 1,000 miles long and 10 to 90 miles in breadth, is an illustration of this type. Atolls differ in being not attached to any visible land. They are circular in shape, surrounding a central lagoon of placid and transparent water. When, as usually happens, there are passages through the reefs, they form an excellent harbour. Fringing reefs simply skirt the coastline.

Corals are closely related to the sea-anemones, belonging to the class *Anthozoa* of the division *Coelenterata*. There are also lime-forming seaweeds and other polyps of the class *Hydrozoa*, which often help in the formation of coral islands.

Cork. The second largest city of the Irish Republic is the capital of County Cork. It stands on the river Lee, 11 miles from its mouth. An important trade in provisions and agricultural products is carried through its harbour; but because its quays can accommodate only vessels drawing up to 30 feet of water, larger craft must use the near-by port of Cobh (see article). Cork has some fine public buildings, including a university college and two cathedrals, one Protestant and one Roman Catholic; the Protestant St. Fin Barre's Cathdral was built on the traditional site of the church founded by the saint. St. Anne Shandon's church has a famous peal of bells and a coloured spire, two sides being of red sandstone and the other two of white limestone. A few miles from the city, within the ruins of Blarney Castle, is the famous Blarney Stone, popularly supposed to give to those kissing it the power of persuasion over others by clever, flattering speech. The city has thriving manufactures of leather, iron, glass, rubber, gloves, textiles, and fertilisers, and contains large shipyards, distilleries, breweries, and flour-mills, also a large car and tractor assembly plant. The population in 1951 was 74,577.



Portuguese Official Bureau

GATHERING CORK IN PORTUGAL

Climatic conditions allow Portugal to produce cork of a particularly high quality, and cork-oak plantations take up about a quarter of the total area of forests in that country. The strips of bark are removed with a curved two-handled knife.

Cork was founded about A.D. 600 by St. Fin Barre, the name of the city (part of it is built on an island in the swampy area of the estuary of the river) being derived from the Erse word *corcaigh*, a marsh. It was frequently pillaged, and for a time occupied by Norsemen in the 9th and 10th centuries. Until 1172, when Ireland acknowledged the sovereignty of King Henry II of England, Cork was ruled by Irish princes. It gained many privileges under the medieval English kings, but lost them after its support of Perkin Warbeck, the Yorkist pretender, in 1492. Six years later, after a siege by the Earl of Kildare, every inhabitant was compelled to swear fealty to King Henry VII. Cork declared for King Charles I in 1642, but surrendered to Cromwell in 1649. Later it supported the deposed King James II, but in 1690 fell to John Churchill (later Duke of Marlborough) after a five-day siege. In the "troubles" of the 1920s Cork was, after Dublin, the most important centre of the Sinn Féin movement, two of its mayors, Thomas MacCurtain and Terence MacSwiney, losing their lives in the struggle for Irish independence. In 1920 and 1922 the city was badly damaged by fire.

Cork. All trees and shrubs produce cork, but only the cork oak, *Quercus suber*, an evergreen tree, of Mediterranean regions, grows enough of it to be useful to man. When twigs, boughs, trunks, and roots increase in thickness, their inner parts expand by multiplication of cells, while the skin stops growing and must eventually crack. Just before this happens, certain layers of cells situated a little way under the skin suddenly become active again and make layers of tiny cells shaped like the bricks in a wall, but hollow. These use up their living contents to make a brown, waterproof, airproof substance called suberin, which lines the cell as a young butterfly collector would line a cigar-box with cork for his specimens. The centre of each cell is then full of

Portuguese Official Bureau

PILES OF CORK WAITING TO BE PROCESSED

The first crop of cork cannot be harvested until the tree is some 20 years old, and subsequently the tree can be stripped only once every nine years. Cork exports now form the most valuable single item in Portugal's export trade, and some 20,000 people are employed in cork processing factories, many more being engaged in cork cultivation.

air, and the whole layer of cells is cork. It protects the delicate inner parts of the plant from drying up, from cold, from fungus diseases, and from rubbing against soil, etc.

The old, cracked skin forms the extra protection known as bark, thick or thin, smooth or furrowed, according to how far under the skin and how continuous the cork-forming cells are. Here and there on twigs are raised dots, the breathing pores called lenticels, which are places where the cork cells have become separated to let air pass between them. Just before deciduous trees shed their leaves, they grow a thin layer of cork right across the place where the leaf joins the twig, so there is no open wound to be healed afterwards. The skin of a potato is made of a thin layer of corky cells. On some varieties of elm and maple one may notice in autumn and winter curious " buttresses " or ridges along the twigs. These break off easily, and one can see and feel that they consist of cork.

The cork-oak forests of Portugal and Spain contribute nearly one-half of the world's annual supply. Thousands of men find work in the deep shade of the gnarled old trees, with their evergreen leaves, and their rough trunks covered with thick grey bark. After the bark has been stripped from the trees, new layers form, so that a fresh sheathing from ½ inch to 2½ inches thick is ready for cutting every nine or ten years. The trees are about 20 years old when they yield their first crop, which is so rough and coarse that it is worth little. The second stripping gives a better quality, but the best harvests come when the oak is some 40 years old.

The stripping is usually done in July or August. With a sharp knife or hatchet a cut is made round the trunk near the base and another just below the branches. These incisions, which must not injure the inner layer or the trees will stop growing, are joined by long lengthwise cuts. Then, using a curved two-handled knife, the workman rips off the sheets. The branches yield a thinner layer, but of fine quality. A supply of from 45 to 50 lb. of cork may be taken from a single tree.

After seasoning for a few days, the cork sheets are boiled in great vats to remove the tannic acid and to soften them so that the hard outer covering can be removed. At a seaport the bark is pressed into bales and loaded on vessels. For making corks the slabs are softened by steaming, then sliced into strips by circular steel knives revolving rapidly. From these strips the corks are cut by other machines. Chips and shavings of cork are compressed to make table-mats, bath-mats, sound-proof walls, and floor-coverings, and for many other purposes.

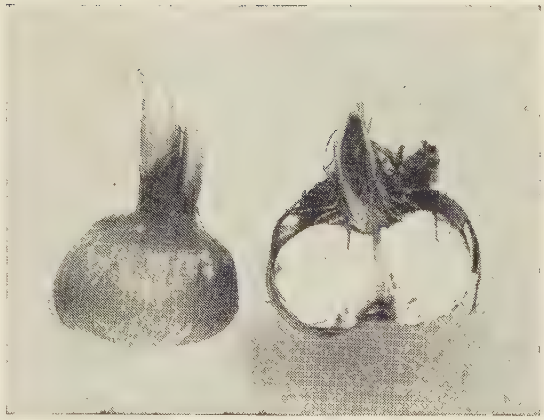
Because cork floats on water, it is used for life-jackets and for ship fenders and fishing-net floats. Some ancient Egyptian coffins were made partly of cork, and the Greeks and Romans put it to several uses. It was not until about the 17th century that it was used for bottle-stoppers in Britain; before this bottles were sealed with wax. The Greeks, however, used it for bottle-stoppers. It is still the best material for stopping wine bottles, which may be laid down for years, because it swells up inside the neck of the bottle, so making it completely airtight.

Corm and Tuber. How the tops of certain plants die away completely and a new generation is provided for by swollen underground growths is explained in the article BULBS. But such food-storage growths are not all classified as bulbs. The bulb-like base (swollen underground stem) of a crocus, for example, is called a corm. This differs from a real bulb in being more or less solid. It is without the bulb's thick fleshy scales—it cannot be peeled, layer by layer, as can the bulb of a daffodil or an onion. When a crocus plant is dug up after flowering, the new young corms are seen resting on the top of the shrivelled old one.

Some underground stems produce greatly swollen growths loosely disposed among the roots and called tubers. The potato plant is an example. Each potato tuber has a number of deeply set buds ("eyes"), and when a potato is cut up into as many pieces as there are eyes, each will grow into a new plant.

The tight clusters of fat brown "sausages" at the base of a dahlia plant's stem, commonly called tubers, are not underground stems but thickened roots. Each tuberous root, detached with a piece of the parent stem and a bud, will give rise to a new plant.

Perpetuation of the species is not entirely dependent on these organs of food-storage. The plants increase also by means of the seed produced by their flowers.



CORM OF A CROCUS

A corm differs from a real bulb in being more or less solid. It has not the bulb's thick, fleshy scales, and cannot be peeled. When a crocus plant is dug up after flowering, new corms can be seen on top of the old one.

Cormorant. Found in very many parts of the world, the cormorant, *Phalacrocorax carbo carbo*, a large, black bird with snaky neck, upright carriage, and fairly long hooked bill, is to be met with on sea coasts, estuaries, and tidal rivers. It lives almost entirely on fish; and its streamlined body, and the powerful legs with their outsize webbed feet set far back, fit the bird admirably for the task of catching its prey below the surface of the water. The flight is steady and purposeful, journeys often being taken many miles over the sea, so near to the waves that the great wings seem to be brushing them. In its search for suitable food the cormorant commonly penetrates up rivers a long way inland. To take an instance in Great Britain, it is frequently met with on Bala Lake, North Wales, a considerable distance from salt water.

A visit to a cormorants' nesting colony on some small, rocky islet during early June is an unforgettable experience. The huge nests, built of small sticks, seaweed, and dried grass, lie close together on the bare rock. Some birds decorate them with green grass and gulls' feathers. A few of these bulky structures contain four or five large, white, chalky eggs. Many are crowded with young birds, some as small as black puddings, others as big as jackboots.

The very young ones are clothed in skin like an elephant's. They have a fleshy pouch under their bills, featherless wings, and short, fat legs which make them clumsy and ungainly. As time goes on they develop warm coats of down and become bold enough to strike sharply at one's fingers when approached. Left undisturbed, they sleep for long intervals through the hot summer days, their black snaky necks hanging motionless over the edge of the nest, awaking only when the swish of the parents' great wings tells them that another meal is at hand.

In the Far East, cormorants are bred and trained to catch fish for their owners. When the tide and wind are right, they are taken to the fishing ground in punt-like boats. A stout band of rubber or soft expanding metal is fastened round the bird's neck. It dives, catches a fish, and brings it in, having been unable to swallow it because of the neck-band. After several dozen such deliveries the bird's neck is freed and it is given a few fish to eat as a reward. (See illustration p. 383, this volume.)

John E. M. Sumner

CORMORANT, THE FISHER BIRD

The cormorant's constant diving after fish deprives the plumage of much of its natural oil, and the bird must dry its wings before diving again. The cormorant, which is about 36 inches long, is black in colour. It is a near relative of the shag, which is a much smaller bird.

Cornflower. One of the most beautiful British wild flowers, the cornflower or bluebottle, is an annual weed of cornfields, growing about two feet high. Its lowest leaves are deeply divided and the upper ones narrow and almost grasslike. *Centaurea cyanus* is its botanical name, and the *Compositae* its family. At the ends of woolly stalks are flower heads supported by brown-edged, overlapping green scales. The minute purplish flowers or florets in the centre of each head have five petals jointed into a tube. Projecting from this is another tube of five long, dark purple anthers (heads of stamens). When the stamens are touched, their thread-like stalks shrink, and white pollen is pushed out of the tube end by a fringe of hairs near the top of the pistil as soot comes out of a chimney when the sweep's brush goes up it; but here the "chimney" moves down over the brush. All the seed-boxes are inside the scaly case. The flowers round the edge of the head are larger, bright blue and trumpet-shaped, with five tapering petals. They have no stamens or pistils but attract bees and other insects towards the nectar in the central florets. In cultivation cornflowers have produced white, pink, red, and purple flower heads. Larger kinds from southern Europe are grown in English gardens.

This flower is the national emblem of Germany.

Cornwall. The county of Cornwall is the least English part of England. A long peninsula straggling out to the south-west, it is bounded on three sides by the sea and on the fourth by the river Tamar, so for centuries it was almost an island. The original Cornish people belonged to the Celtic tribes who inhabited Britain until the English (or Angles) arrived in the 5th century and drove them back into Wales and Cornwall. Until about 200 years ago the Cornish had their own language, which is similar to Welsh and Breton.

This is still a strange county, and its 1,365 square miles are full of contrasts. Parts of the coast are wild and barren, like Tintagel, where the high cliff is crowned with the ruins of a castle, said to have been King Arthur's. Farther south are fishing villages that might be Mediterranean, with rich colours, palm trees, and cliffs blazing with the spring flowers that are one of Cornwall's "exports" to the rest of England. There are industrial towns like Redruth and Camborne, with their tin mines, and St. Austell, with huge china-clay works; and in the countryside around you can see stone monuments set up 4,000 years ago by a people even older than the Celts.

Fishing used to be a thriving industry, but to-day only small fleets work round the coast, which is very dangerous for shipping. In days of sail, wreckers would lead donkeys along the cliffs at night with lights swinging on their backs like boats riding at anchor, so that merchant ships would turn towards them and be wrecked. The broken coastline, with its small coves and many caves, made it a centre of smuggling.

With its magnificent cliffs and picturesque harbours, the county attracts not only holiday-makers but also painters. There is a well-known, long-established group at St. Ives, in the north; and at Polperro, in the south, so many painters sit around at vantage points that the villagers do not even bother to stare. Places like Newlyn, Sennen Cove, Lamorna, Mousehole (pron. mowzl) and Mevagissey are pictured over and over again.

Cornwall is full of legends about the stone monuments, caves, and places like St. Michael's Mount—a miniature mountain rising from the sea

J. Dixon-Scott

CORNWALL'S RUGGED AND PICTURESQUE COAST

Veryan Bay is one of the many inlets along the Cornish coast that are noted for their beauty and have been painted so often by British artists. The county is the background of much of the literature concerning King Arthur; and Tintagel is one of the spots associated with this legendary British monarch. The Cornish language, which is akin to Welsh and to the speech of the Bretons in France, died out during the second half of the 18th century.

CULTIVATED VARIETIES OF THE CORNFLOWER

An annual weed of the cornfields, the cornflower or bluebottle is one of the most beautiful British wild flowers – and the blue heads are conspicuous amongst the pale gold of the wheat. In cultivation cornflowers have produced white, pink, red, purple, and variegated flower heads, which are much larger than those of the wild plants. The cornflower, common over most of Europe, N. America, and western Asia, is a member of the Compositae family.

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MAGNIFICENT CEREMONIAL OF THE CORONATION

Medieval splendour and consummate pageantry mark the crowning of the monarch in Westminster Abbey. This picture, taken at the Coronation of Queen Elizabeth II in 1953, shows Her Majesty, newly crowned by the Archbishop of Canterbury with the Crown of St. Edward, being escorted from St. Edward's chair (centre) to a Throne upon a dais, there to receive the homage of bishops, princes of the blood, and peers of the realm.

off Marazion, with a castle on top and a tiny harbour at the foot. Many legends are about King Arthur: his sword Excalibur is supposed to have been thrown, when he was dying, into Dozmary Pool on Bodmin Moor. But the strangest story of all says that between Land's End and the Scilly Isles, 24 miles away, lies the lost land of Lyonesse beneath the waters. Archaeologists and historians have other views, but in the Cornish atmosphere anything seems possible. The county has preserved many ancient mystery plays; several have survived in the old Cornish speech.

Since the days of the Black Prince it has been a royal duchy, and the Sovereign's eldest son (now Prince Charles) is always Duke of Cornwall. Bodmin is the county town, but the council offices are at Truro, which is the seat of a bishop.

Coronation. The crowning of kings and queens has been the centre of a solemn religious ceremony for many centuries. In Britain the Coronation ceremony, with its beautiful ritual and rich display of pageantry, is perhaps the strongest link retained with the country's glorious past. Alterations have been made to the form and order of the service as the generations have gone by, but it is true to say that in everything that matters Queen Elizabeth II was crowned in the same fashion as Richard Coeur de Lion.

The most important parts of the service are the administration of the Coronation oath, in which the Sovereign promises to govern the people according to their laws and customs; the anointing with oil, on the head, breast, and palms of the hands; the investing of the Sovereign with the orb, the sceptre with the cross, the sceptre with the dove, and other emblems of earthly majesty, power, and justice; the placing of St. Edward's Crown upon the brow of the Sovereign by the Archbishop of Canterbury; and finally the enthronement, and the homage of the bishops, the princes of the blood royal, and the peers of the realm. The whole ceremony is set within the service of Holy Communion. Since William the Conqueror, almost every Coronation ceremony has taken place in Westminster Abbey.

It was King Edward I who ordered the Coronation chair to be made which is still used. Fashioned of English oak, it was first used for the coronation of Edward II in 1307. It has had some rough treatment during its long history. The back, sides, and seat are covered with names and initials, many of them cut into the wood by boys of Westminster School 200 years ago. Roughly carved on the seat are the words: "P. Abbott slept in this chair 5, 6 July 1800." Under the seat is the massive "Stone of Destiny."

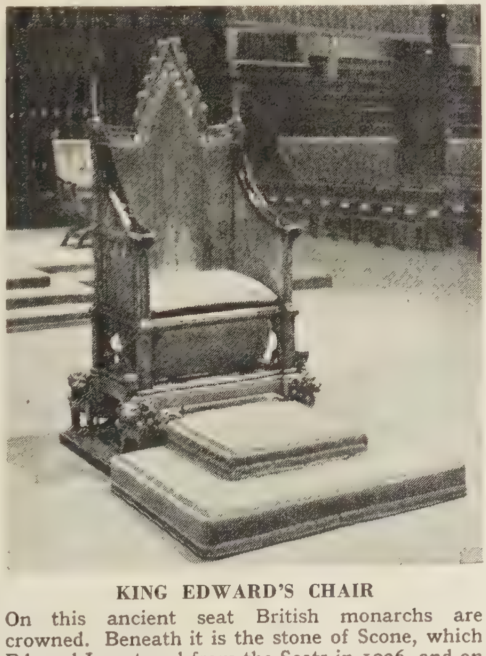
CLIMAX OF THE CORONATION

The ceremony reaches its climax when the Archbishop of Canterbury places St. Edward's crown upon the Sovereign's head. In this picture of Elizabeth II's Coronation the rod with the dove is seen in the Queen's left hand.

This stone is so old that no one knows its origin. Some people say it is the stone on which the patriarch Jacob rested his head at Bethel (Genesis, chapter 28). Long ago in Ireland (where it received its name *Lia Fail*, or Stone of Destiny) the kings of Munster sat upon it to be crowned. Thence it was taken to Scotland, where for centuries it was used as the coronation seat of the Scottish kings. In 1296 it was brought to Westminster by Edward I to symbolise his conquest of Scotland. And there it remained until it was surreptitiously removed by Scottish nationalists on Christmas Day 1950. It was soon returned.

Scottish kings continued to be crowned at Scone without the stone, the last being Charles II in 1651.

For hundreds of years the Coronation ceremony was accompanied by a banquet in Westminster Hall, at which the hereditary King's Champion



KING EDWARD'S CHAIR

On this ancient seat British monarchs are crowned. Beneath it is the stone of Scone, which Edward I captured from the Scots in 1296, and on which the Scottish kings had long been crowned.

THE STATE COACH AWAITS THE NEWLY-CROWNED QUEEN

After the Coronation ceremony has been performed in Westminster Abbey, the monarch returns to Buckingham Palace to the acclamations of the crowds who pack the gaily decorated streets of London. Here from the specially-built annexe before the west door of the Abbey, Queen Elizabeth II enters the gilded state coach after her crowning on June 2, 1953. On that occasion very wet weather failed to damp the enthusiasm of the populace.

used to ride in on a horse and throw down his gauntlet as a challenge to anybody who might dare to dispute the rights of the newly-crowned monarch. The banquet was discontinued at the Coronation of William IV, and has not been revived. But the most popular pageantry of all remains—the procession in state through the streets of London, from the Abbey to Buckingham Palace, of the Sovereign in the wonderful gilded coach, wearing the Imperial State Crown (*not* St. Edward's Crown), and carrying orb and sceptre.

At the Coronation of George V in 1911 a single photographer was allowed for the first time to take a photograph of part of the Abbey ceremony. At that of George VI in 1937 not only was almost the whole service broadcast throughout the Commonwealth, but films were made in the Abbey. With the Coronation of Elizabeth II in 1953 came an additional marvel—television, which enabled millions of the Queen's people to share in the ancient ceremony, and perhaps to realize for the first time the essential solemnity of it all; and films were made in colour.

Another change has been the increasing participation in the ceremony of representatives of the various nations and peoples of the Commonwealth. Finally, although the service is a Church of England service, in 1953 for the first time an important role in the ceremony was allotted to the Moderator of the Church of Scotland, of which the Queen is also the head.

Coronation normally follows within twelve months of accession instead of immediately, as formerly.

Corot, JEAN-BAPTISTE CAMILLE (1796–1875). People used to see in the streets of Paris a kindly-looking old gentleman with a mass of white hair, wearing the blue blouse of a peasant, and they would say: "There goes Father Corot." He had become one of the most famous painters of the day. His landscapes were selling for some thousands of francs apiece; but his greatest pleasure, next to painting them, was to give away the money they brought him. He was particularly generous to needy young artists.

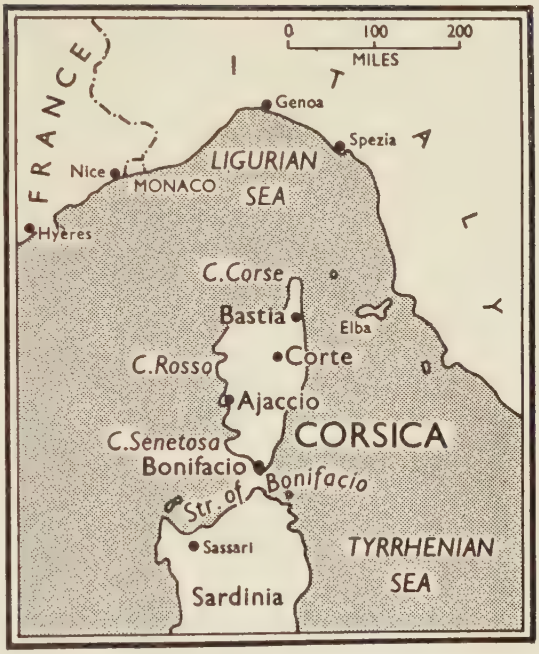
The tranquil scenes Corot (pronounced kor′ō) loved to paint reflect his own happy life. He never suffered the privations that come to many artists, and he never lacked friends. There were years when the quiet tones and shades in which he painted were appreciated only by his pupils and fellow artists, but he was always happy if he could demonstrate on canvas the beauties of nature as he saw it. He liked to depict misty dawns, hazy trees, and mirroring waters, and his beautifully composed paintings are distinguished by a silvery, atmospheric, almost dreamy quality, as if they had been painted with a feather rather than a brush. They have been likened to soft piano music.

Corot is one of the greatest and certainly the most popular of the so-called "Barbizon school" of painters, who painted at the little village of Barbizon on the edge of the Forest of Fontainebleau, some 37 miles south-east of Paris. These artists were among the first to popularise the art of landscape-painting in the open air. But Corot's usual practice was to make sketches in the open air

all the summer, then work them up into pictures in his studio in the winter. His work is to be seen in many French galleries, and also in England in the National Gallery, the Tate Gallery, and the Wallace Collection. There is a particularly beautiful one, "Dance of the Nymphs," in the Glasgow art gallery.

Corsica. France acquired Corsica from Genoa in 1768. The following year, on August 15, 1769, the most important event in Corsica's history took place, the birth of Napoleon Bonaparte at Ajaccio (*see* NAPOLEON I). Corsica lies in the Mediterranean Sea, about 100 miles south-east of France, due south of Genoa, and separated from the island of Sardinia on the south by the Strait of Bonifacio. It has an area of 3,367 square miles; its length is 110 miles, and its greatest breadth 53 miles. The population in 1954 was 244,266. Years of Genoese misrule, and the Bonapartist tradition, make Corsicans loyal to France rather than to Italy. The language of the people is, however, mainly Italian. The capital is Ajaccio, on the west coast; the largest city, Bastia, with about 40,000 inhabitants, is on the north-east coast.

The surface is mountainous. The highest peak, Monte Cinto, reaches 8,889 feet. There are many extensive forests of pines, evergreen oaks, cork trees, beeches, and chestnuts. Although the soil is fertile, agriculture is backward and scarcely enough grain is produced for home consumption. Chestnuts are ground into flour and form the chief food of many of the poorer inhabitants. Olives, grapes, oranges, and lemons are grown abundantly, and



these, together with wine, oil, and fish, are the chief exports. The chief minerals are fine granite and marble.

Corsica was first colonised by the Phoenicians; it was acquired by the Romans, who gave it its present name, and was for periods held in turn by the Vandals, the Goths, the Franks, the Saracens, the Pisans, and the Genoese, before it was purchased by the French. During the wars of the French Revolution and of Napoleon, Corsica came for a time under British rule. It was regained by the French in 1815, and since then has formed a department of France. The island was occupied by German forces after the surrender of France in June 1940 during the Second World War. On November 11, 1942, it was annexed by Italy, but following the surrender of Italy to the Allies in September 1943 it was again garrisoned by Germans, who were attacked by French patriots assisted by French and American troops,

A LOVELY LANDSCAPE BY COROT: "THE POOL"

Corot was one of the happiest of landscape painters, and his renderings of tranquil beauty make a universal appeal. In the summer he made studies in the open air, and in winter he returned to Paris and painted his pictures from the material he had gathered. The example above is called "The Pool," and is in the Louvre, Paris. In England there are examples of Corot's work in the Wallace Collection and the National Gallery, London.

until all organized German resistance had ceased by October 4, 1943.

The people of Corsica are proud, hardy, and quarrelsome, and over long periods banditry and the blood-feud were rife in the island.

Cortés, HERNANDO (1485–1547). In 1518, the year before Magellan sailed from Spain on his great voyage round the world, a Spanish expedition led by Hernando Cortés (pron. kortāz′) left Cuba to conquer Mexico. This military adventurer was the son of a poor Spanish nobleman. Born at Medellin in Estramadura, he went to the West Indies in 1508 in search of adventure, and became secretary to Diego de Velazquez, governor of Cuba. He had no sooner got ready his expedition when Velazquez repented of the appointment and sent word to Cortés to give up his leadership. But Cortés succeeded in getting away, and landed on the shore of Mexico in March 1519.

To prevent the desertion of his men, he sank all his ships except one, which he dispatched to Spain with a statement of his case as soon as he landed. For long the Mexicans had had a tradition of the return of a fair-skinned god, and when they learned that white strangers had come they flocked in their thousands to do homage to what they thought was their returning god.

Cortés founded Vera Cruz and then marched two-thirds of the distance to the town of Tenochtitlan. There, with his small army, he defeated 50,000 badly-armed natives, who had begun to doubt his divine origin. These natives then joined the Spaniards as allies in their march upon the Aztecs (see article) who ruled Mexico. About 70 miles from the Aztec capital Tenochtitlan (now Mexico City) Cortés defeated an attack by the Aztecs. Montezuma, the Aztec chief, offered no further resistance, and in November 1519 the Spaniards entered his capital, situated on several islands in a lake. To guard against sudden attack, Cortés kept Montezuma as his prisoner.

Velazquez, angered by Cortés' disobedience, and jealous of his successes, sent 1,200 men to recall him to Cuba. Cortés, however, persuaded these men to join him. Then the Aztecs deposed Montezuma, and elected a new ruler. They attacked the Spaniards, and in a terrible night retreat Cortés lost more than two-thirds of his men, but he did not give up. After winning the battle of Otumba in July 1520 he besieged the island city and, despite desperate resistance, took possession of it once more in August 1521.

But jealous enemies were plotting his ruin in Spain. To protect himself, Cortés returned home in 1528. He was received with great honour by the king of Spain, Charles V, but he returned to Mexico merely as a military commander, while another man was appointed to govern the province he had won. Cortés continued his exploration of Mexico and reached California. The governor constantly hindered the soldier in his expeditions, and Cortés returned to Spain in 1540.

Cortés obtained nothing from the king, and spent the remainder of his life in neglect. He was a man of courage, perseverance, and resourcefulness, but his career was marked at many points by unscrupulousness and cruelty.

Cossacks. "The Cossacks! The Cossacks!" On many occasions in the days of Tsarist rule in Russia these words were the signal for a mad scramble of the rioting people, as these fierce soldiers, mounted on shaggy ponies, swept down the streets. Their reputation for ruthlessness was equalled only by their renown for amazingly skilful horsemanship.

The adventurous ancestors of these hardy cavalrymen had settled in the 16th century in the vast steppes of south-eastern Europe, which stretch from the river Dnieper to the Ural Mountains. There a mixed population grew up, composed of Russian, Polish, and Tartar elements, and distinguished by the fact that its members were free men and not serfs, and by their unsettled modes of life. With a persistence lacking in the ordinary Russian peasants, they played a notable part in the exploration and colonisation of Siberia. One of their leaders was the famous Mazeppa (1644–1709), who with some 80,000 Cossacks aided Charles XII of Sweden against Peter the Great of Russia. They were more or less independent, and not finally absorbed into the Russian Empire until the 18th century.

Under the Tsars the Cossacks were treated as

COSTA RICAN ROPE-MAKING

One of the commonest plants in Costa Rica is hemp, whose fibre makes it valuable for making strong cords and ropes, rough sailcloth, and the base of tarpaulins. After passing through sorting and processing chambers, the hemp fibres are twisted and intertwined to make good string, or some of the toughest ropes in the world.

military communities possessing special privileges, such as tax exemption and self-government within the Russian Empire. In return, the men trained as soldiers from an early age and served as light cavalrymen in the Tsar's armies. After the Russian Revolution of 1917 they were often in conflict with the Bolshevik government, at whose hands they suffered considerably. Later, certain of their former privileges were restored to them; and units of Cossack cavalry were incorporated in the Red Army.

Costa Rica (pron. kos'*ta* rē'k*a*). This small country of Central America was discovered by Columbus in 1502. It lies south of Nicaragua and north of Panama, with the Caribbean Sea to the east and the Pacific Ocean to the west (see map under CENTRAL AMERICA). A region of great forest and mineral wealth, it is also a land of volcanoes and earthquakes.

Nearly all the people live on a cool and fertile plateau in the central part, about 3,500 feet above sea-level. The highest mountain, Chiripo Grande, reaches 12,447 feet. From Mount Irazu (11,320 feet), near Cartago, the old capital, can be seen farms, and on almost every hill the home of a coffee planter. On this plateau has grown up a nation different from that of any of the other Central American republics. The great majority of the 1,000,000 inhabitants are of Spanish descent. In the 16th century the Indians employed by the Spanish settlers were wiped out by disease, so the Spaniards had to abandon their aristocratic traditions and work the land themselves. The native Indian population has now dwindled to a few hundreds, and there are about 15,000 West Indian Negroes. The majority of peasants own their farms and can read and write. The capital, San José, with its one-storey red-brick houses, has a population of 128,000. Limon, on the Caribbean coast, is the principal port. The area is 19,695 square miles.

LIMPID LANDSCAPE BY COTMAN

This water-colour painting of New Bridge, Durham, by John Sell Cotman, shows this artist's skill in achieving his effect by flat washes in varying weights of tone, each with its edges precisely defined, almost as though the picture were built up architecturally by pieces of transparent paper shaped and placed one over the other.

Agriculture is the leading industry, coffee, cacao, and bananas being the chief crops. With the exception of the gold, silver, manganese, and salt mines, the mineral wealth of the country is at present little developed.

After centuries of mismanagement under Spanish rule, Costa Rica joined in the general revolt of the colonies against Spain in 1821 and has been an independent state since that year, except from 1824 to 1829, when it was a member of the Confederation of Central America. Costa Rica has always tended to stand apart from the other Central American republics.

Cotman JOHN SELL (1782–1842). One of the most individual contributions to the world's art was made by the English water-colour landscape painters of the earlier years of the 19th century. It seemed as if in water-colour painting they had discovered the ideal medium for depicting that quietly harmonious and luminous quality which is so characteristic of the English scene. No painter

ever expressed that particular quality more happily than Cotman. He also possessed a unique "decorative" sense that made his simple pictures all the more pleasing. He laid his colours on the paper in a series of neat, flat, transparent washes, each one like a clear and precise statement of fact; and the final effect was a harmonious pattern of light tones, dark tones, middle tones—greens, blues, browns, greys. You will find a reproduction in colour of his fine picture of the old bridge over the river Greta, in the North Riding of Yorkshire—which many judges think the most beautiful water-colour ever painted—with the article on ENGLISH PAINTING in Vol. 3.

Cotman was a native of Norwich, and taught drawing first in schools in that city, then at King's College, London. He led an uneventful life, and did not make any kind of fortune. He exhibited at the Royal Academy for some years but was never elected to membership. Now he takes rank among the great. His paintings are highly prized by collectors, and any art gallery that is fortunate enough to possess an example of his work cherishes it as a great treasure.

PLANT *from which* OUR CLOTHES ARE MADE

Cotton. It is very appropriate that so much clothing is made from cotton, because cotton cloth comes from a white fleecy fibre which nature wraps round the seeds to keep them warm while they are ripening and to protect them on their journey when they are blown by the wind from the bolls of the plant. Cotton was the first of all plants to be cultivated for any purpose other than that of providing food, and since the most distant historical times men have gathered the soft fleecy fibres, spun them into thread, and woven the thread into cloth.

Thousands of years ago cotton was being grown for cloth-making in ancient Egypt, where its cultivation had been introduced from India. The word itself originated from "qutun," the old Arabic name for the plant. The writers of Classical Greece and Rome frequently refer to cotton cloth. Columbus found it being used in the West Indies in the 15th century, and its use had long been known to the early civilizations of Mexico and Peru.

The plant belongs to the mallow family, and it is thus a relative of the hollyhock, the flower of which is not unlike the cotton bloom.

Cotton Board

COTTON FLOWER

The cotton flower has a spread of two inches and its colour, which varies with the species, changes from day to day.

Wild cotton sometimes grows to a height of 20 feet, but the cultivated varieties are generally between three to six feet high. It thrives best in tropical and warm-temperate climates, as it needs a long growing season of at least 200 days free from frost; a plentiful but not very heavy rainfall; and warm, bright, but not excessively hot, sunshine. The parts of the world where these conditions are found (called the cotton belt) are bounded by two lines on the map—one 43 degrees north of the equator and the other 30 degrees south of it. Between these limits lie India, Pakistan, Egypt, the Sudan, Peru, Brazil, the southern parts of the U.S.S.R., and the southern states of the U.S.A., all of which are great cotton-producing countries. Most of the cotton cultivated for commercial use comes from the regions bounded by the line north of the equator.

The United States is the biggest grower, furnishing about a quarter of the world's total production. Texas, Mississippi, Arkansas, Alabama, Georgia, South and North Carolina, Louisiana, and Tennessee are the chief producing states. As its name suggests, "sea island" cotton is grown on the flat islands along the coasts of Georgia, northern Florida, and South Carolina. This is the best of all types, producing fibres up to $2\frac{1}{2}$ inches long. It is also grown in the West Indies, and has been transplanted with success to Egypt and to some of the Pacific islands.

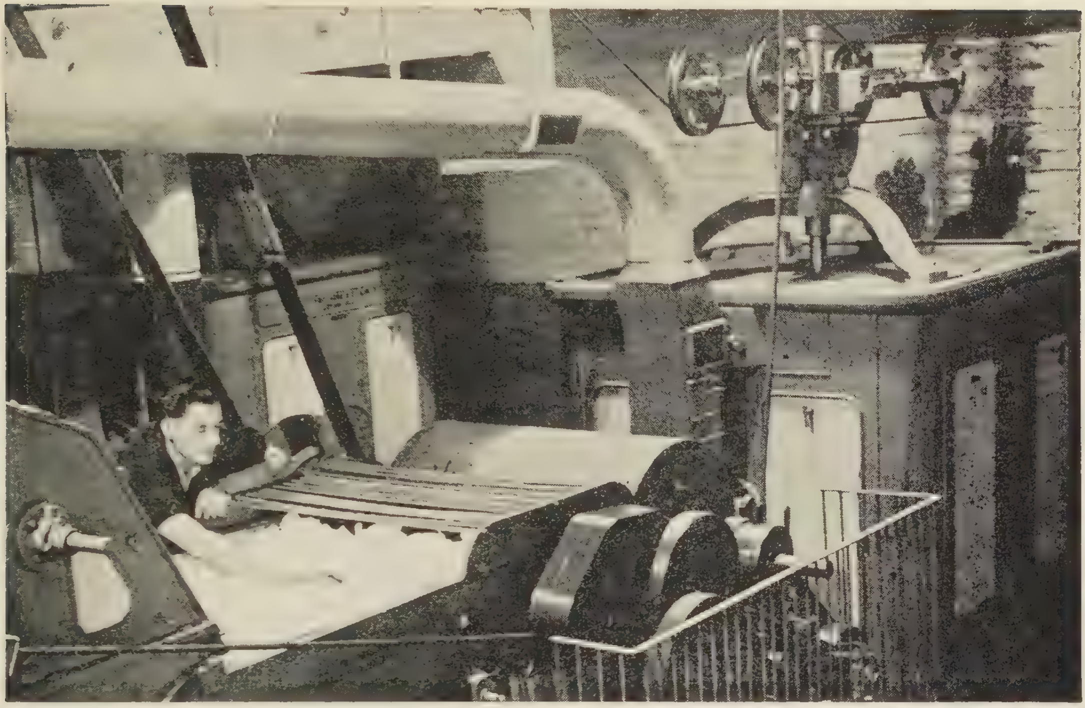
Next to the United States in quantity of cultivation come India and Pakistan. The fibre of cotton grown in the Indian continent varies from half an inch to one inch in length. Except for some exported to Japan, most of it is now woven into cloth in the country of origin. Russia, China, and Brazil come next, but they, too, use most of the crop themselves. Large quantities are also grown in East Africa and Peru.

Although the smallest of the world's producers, Egypt and the Sudan, grow the best cotton, their methods of growing are very wasteful, because few of the plots are more than five acres in extent. This makes the cotton very expensive to harvest, collect, and pack for transport to the mills either at home or overseas.

In Egypt and India the cotton-fields are nearly all artificially irrigated, and the various processes of preparing the fibres for baling are mostly carried out by hand. In the southern states of the U.S.A., however, the plantations are able to depend upon natural rainfall, and apart from the actual picking of the fibres, most of the work is done by machinery.

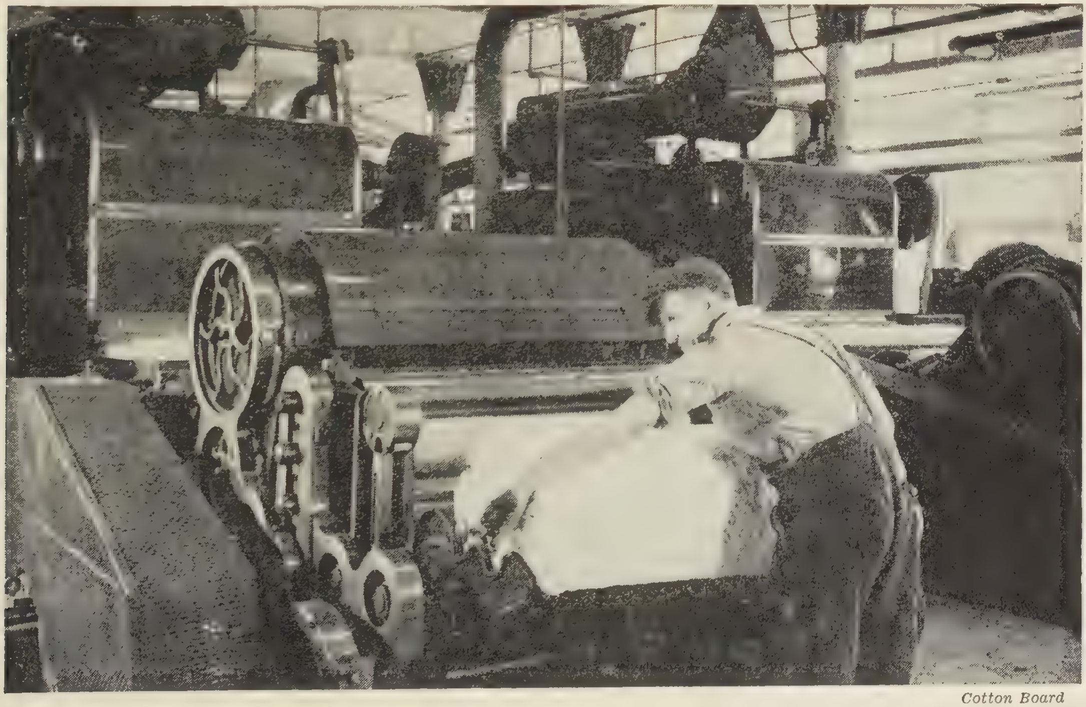
American cotton-fields are sown in the spring. The plants grow into sturdy little bushes with glossy green leaves. The blossoms are snow-white at first, then turn through pink to deep red. Finally the red petals drop off, leaving the cotton boll, a small green capsule about half an inch in diameter and filled with seeds. For nearly two months the cotton boll swells, until it is about the size of an egg, and its colour turns to brown. The cover or husk then splits along four or five seams and the ripe cotton fibre bursts out in the form of a bunch of soft white down about the size of a tennis ball. A crop of cotton does not all ripen at once, so that the same field will show white, pink,

FROM MATTED FIBRE TO FLEECY ROLL



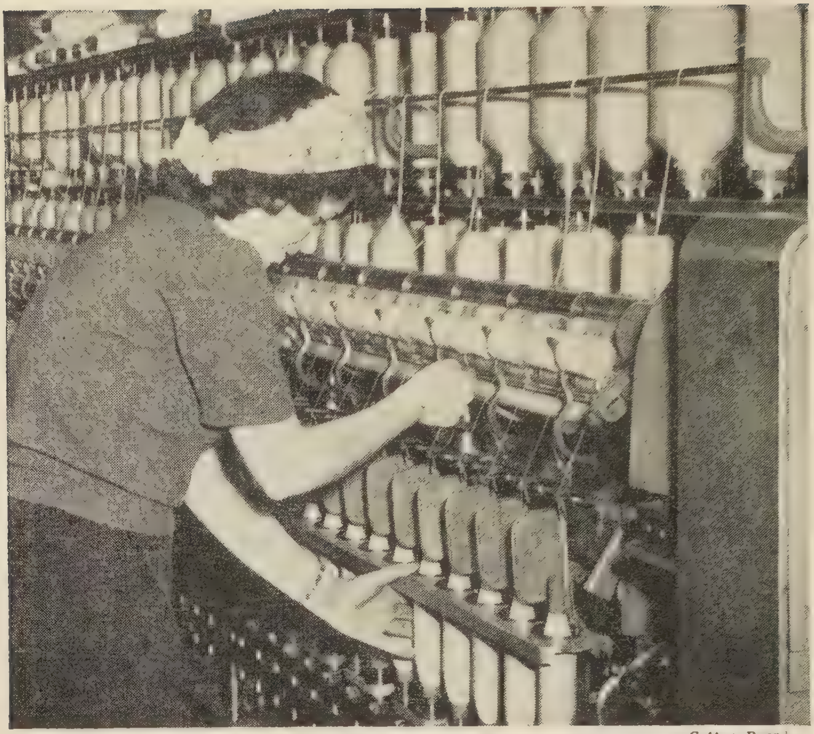
Cotton Board

Arrived at the mill, the bales of cotton are opened, and layers from each are fed by hand into bale-breaking machines. These machines break down the thickly-matted fibres and ensure a thorough mixing of the cotton, which is often of varying grades. The cotton then goes to a machine which beats and blows out the dust and dirt until the cotton becomes a mass of clean fluff. Despite the rough treatment which the cotton receives in the cleaning machines, the cotton fibres are undamaged and retain their strength and elasticity. A humid climate is best for working.



Cotton Board

After it has been cleaned, the cotton is rolled and sorted in a machine called a scutcher, which delivers it in the form of a fleecy sheet similar to a huge roll of cotton wool, as seen in this picture. The roll is called a lap, and if the cotton has been properly scutched right through, the lap will be of the same thickness throughout its length.



REPAIRING A BREAK IN THE COTTON THREAD

During the many processes through which cotton must pass before it is turned from fluff into thread, it is constantly being wound on to bobbins, becoming finer and finer until a yarn is produced ready for weaving. The machine here seen is called a ring frame.

bales cotton fibre at the rate of two tons an hour. This type of gin consists of a number of circular saws placed on a shaft to form an almost continuous roller. As the cotton is fed into the gin, the saws take hold of the fibre and tear out the seeds, which fall through holes beneath the saws, while a brush sweeps the cotton into huge sacks, each holding 477 pounds. Another part of the machine then presses the cotton tightly into the sacks and fastens them with strips of steel into tight bundles ready for shipment.

Just as the cotton fibre is used to clothe man, so the seeds help to feed him. Oil from cotton seed is used for cooking and to make margarine, while the crushed seeds are pressed to make oil-cake for cattle. A form of sugar called xylose is obtained by distilling cotton seed husks.

Enormous quantities of Egyptian and American

and red blossoms, green bolls, and tufts of cotton fibre. When the plant is growing wild, the fluffy balls of fibre break away from it and carry the seed far and wide to fall and take root.

Immediately the cotton bursts from the bolls it is ready for picking, and on the American plantations this is done by Negroes, who walk between the plants dragging after them large sacks into which they place the crop they pick by hand. Because of the different times of ripening, the fields must be picked several times.

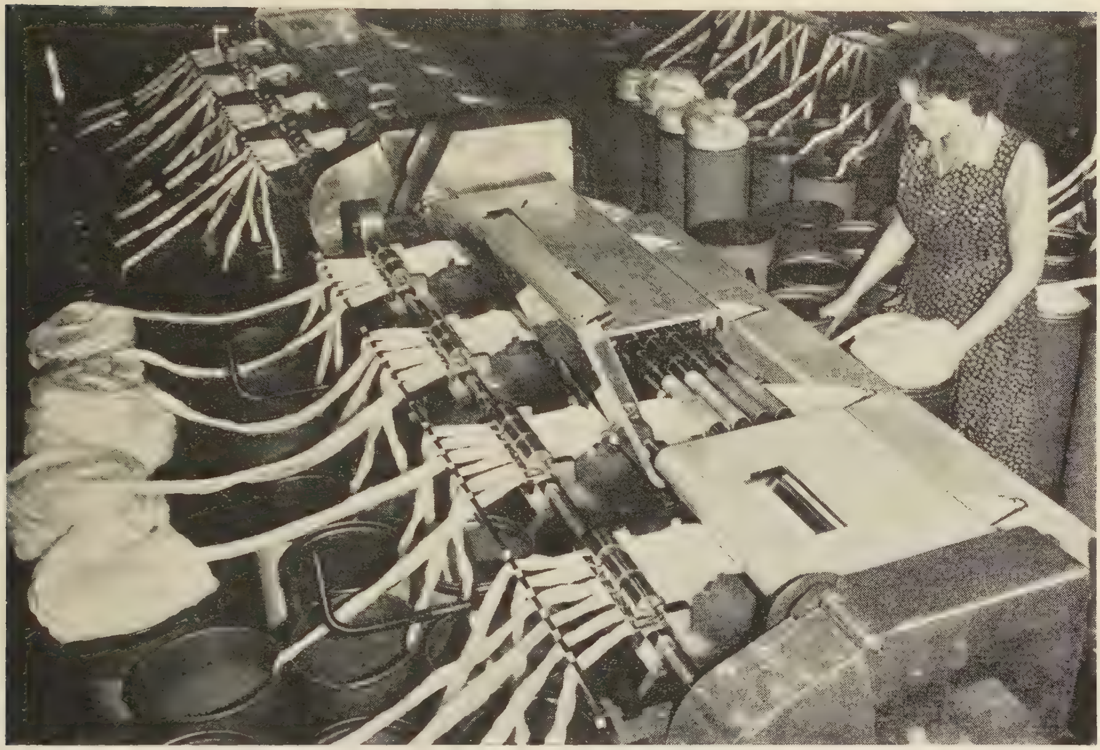
Picking by hand is not only slow and tedious but expensive, even with cheap Negro labour. Consequently, many attempts have been made to use picking machines, but none of them has proved very successful. One such machine consists of a sled with rake-like steel claws which is dragged over the plants and strips off the cotton. But it has the great disadvantage that it strips ripe and unripe plants, besides collecting large quantities of leaves and earth which have to be separated from the fibres afterwards.

Before the cotton fibre, or, as it is called, the lint, can be used, it must be separated from the seeds which it surrounds. At one time this had to be done by hand, and it was a full day's work for one person to seed a pound of cotton fibre. The first seeding machine, or cotton gin, was invented at the end of the 18th century by Eli Whitney (1765–1825) and was able to do in one day the work which had formerly needed 50 men.

Since then the cotton gin has been greatly improved and the machine used to-day seeds and

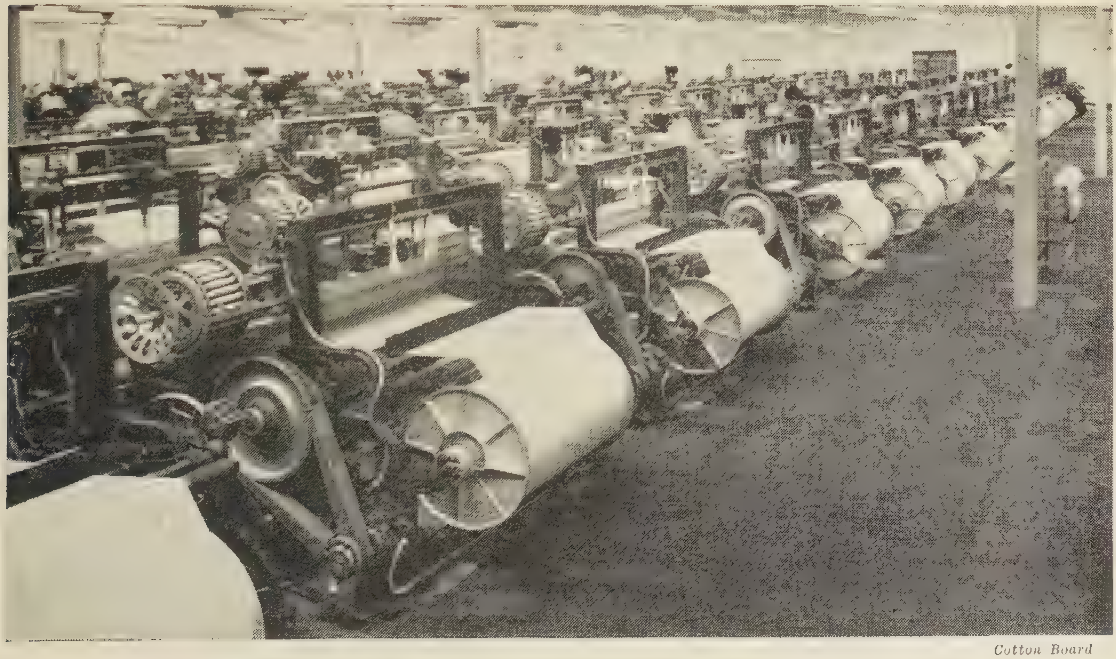
A ROPE OF COTTON FLUFF

From the scutcher the lap goes to the carding machine, which removes the short and useless fibres. As shown, the carded cotton comes out as a loose rope called a sliver, and is wound into a cylindrical container.



Cotton Board

The containers, each with its long sliver of cotton, next go to a machine called a drawframe. Groups of six slivers are seen between the rollers on the frame, which draw them out as a ribbon of cotton with the fibres lying parallel to each other. After passing through the rollers, the ribbon of cotton is pulled through a narrow opening, which forms it into a sliver once more. But this finished sliver is turned out six times as long as the original sliver.



Cotton Board

In this picture of an automatic loom weaving shed, a number of machines are producing cotton cloth with a minimum of attention. In an automatic loom the shuttle is changed mechanically when nearly empty, the old one being pushed aside and replaced by a new one. The operator has to see there is a reserve of full shuttles, and to repair breaks when there is a stoppage. One person can readily take charge of eight or even more machines.

cotton are shipped to Great Britain for spinning into thread and weaving into cloth. Lancashire is the centre of the cotton industry in Great Britain; partly because it has the damp atmosphere necessary for the handling of the cotton fibres without their becoming brittle; partly because most of the machines for handling and processing cotton were invented in Lancashire; and partly because Lancashire has, in Liverpool, the great port nearest to America for receiving the bales from that country.

After the bales arrive at the mill, they are opened and their contents are mixed in a bale-breaker to secure the greatest possible uniformity of the fibres. The breaker also loosens the cotton so that it becomes fluffy again. The loosened fibre then passes to a machine which beats out all the dust, which is sucked out with fans. The next machine further cleans and sorts the fibres so that they are formed into a continuous sheet of fluff. This is rolled by a machine called a lapper, which turns it into solid rolls of fibre each about 45 yards long and weighing about 40 pounds. Another machine, called a scutcher, runs four laps or rolls together, so making the lap more uniform.

Cotton Board

PRINTING A PATTERN ON COTTON CLOTH

In printing a coloured pattern, each colour in turn is "squeezed" through a specially treated screen of pure silk on to the fabric, the screen ensuring that each part of the pattern receives its appropriate colour. This process is called screen printing. Clothing and household furnishings use one-third of Lancashire's cotton output.

At this stage the fibres are still twisted and matted together, and to straighten them out the laps are put through a carder. This is a large revolving cylinder partly surrounded by rollers fitted with fine teeth made from steel wire. There are also teeth on the cylinder to the number of 600 per square inch. As the cylinder revolves, the laps of cotton fibre pass between the two sets of teeth which comb the fibres into line. The cotton then goes to another cylinder, called a doffer, which has teeth set in an opposite direction to those on the first cylinder and moves much more slowly. The action of the doffer reduces the thickness of the lap about two thousand times, so that it becomes a very fine fleece.

Now in the form of a sheet as delicate as cobweb, the cotton passes through the drawing frame, a series of funnels and rollers which draws out the cotton and arranges the fibres so that they all lie in the same direction, and the cotton comes out in a fine strand called a sliver. Six slivers are drawn out and combined to form one strand, and the strand further drawn out and twisted into fine strands called rovings.

From the roving machine the strands go to the spinning machines, where they are repeatedly twisted and rolled, becoming thinner and thinner until a fine yarn is produced ready for weaving (see article). Yarn can be spun so fine that one pound of it would measure 150 miles when stretched out. This is known in the cotton industry as a 300 count. A count is the number of hanks, each of 840 yards, obtained from one pound of yarn. The lower the number, the thicker is the thread. Reels of sewing cotton are numbered on this principle. No. 60 cotton is a fine thread for delicate sewing, No. 30 is a rather coarse tacking-cotton.

During weaving, the cotton yarn can be mixed with silk, wool, linen, or man-made fibres (*see* RAYON). A special glossy cotton, called mercerised cotton, is made by first treating the yarn with a solution of caustic soda, which causes the fibres to swell and so become transparent.

Each year Lancashire imports about one-fifth (360,000 tons) of the world's cotton crop, but only one-third of the output of the mills is used for clothing and household furnishings. Two-thirds is used in industries making pneumatic tyres, belting for machinery, bags, oilcloth, shoes, tents, tarpaulins, explosives, and plastics. Cotton linters, the short fibres next to the cotton seed, are used for mattresses and felting, and in making rayon.